The Glass Industry
REG. U. S. PAT. OFF
Vol. 7 JUNE, 1926 No. 6

Keeping Records of Gas Producer Operations

By Bjarne Schieldrop

The method of keeping records of performances varies according to the purpose for which they are intended. In most producer plants a log sheet is kept and entries made at certain intervals giving the height of the fuel bed and ashes, location of the incandescent zone, speed of the coal feeder, temperatures at various points, etc. From the point of view of the man in immediate charge of the producers, these logs are of great value. They show him at a glance if his orders are carried out and also place him in a position to anticipate trouble before it occurs. The effect of these logs upon the operator is the same as that of a time clock.

They will show the man in charge if his orders are carried out, but unless the nature of the entries are carefully planned and co-ordinated along certain lines they will not give him a basis upon which to give his orders. Their usefulness has passed the day after they are made, and if they are filed they seldom give information of any value beyond settling minor disputes when referred to at a later date.

If the purpose of the records is to enable reproduction of desired conditions or to foretell effects of proposed changes, a careful planning of the entries and their keeping becomes necessary. It is imperative that all those factors which influence operation are included in such records and that irrelevant matter is kept out, so as not to complicate the system.

The best gas for glass melting purposes is obtained by maintaining the highest possible temperature in the fire zone consistent with an easy working fuel bed free from clinkers. In order, therefore, to get the greatest benefit from any class of coal used it is necessary to reduce the amount of steam used in the blast to the lowest possible limit which that coal allows. That this quantity will vary with the different classes of coal will be seen by referring to Table 1.

The figures in this table are averages of those given in Bureau of Mines Bulletin No. 209. The softening points of the ash, which of course determines the clinkering points, vary by more than one thousand degrees, and the steam requirements will vary accordingly.

If it were possible to compute a table, applicable to all conditions, giving the blast temperature in relation to the softening point of the ash, matters would be greatly simplified. But there are too many conditions peculiar to each individual installation to make such a course practicable. The first purpose of the record will therefore be to create a table of this nature.

Due to location and cost of transportation most plants are limited in their choice to a few classes of coal. As, furthermore, the fusibility of the ash varies but little within the same vein or mine, there is little difficulty in obtaining figures on this point for any coal either used or considered for adoption. This should be the first, and it is perhaps the most important item for the record.

By referring to Table 1 it will be seen that a certain relation exists between the sulphur content of the coal and the softening point of the ash. This relation has its excep-

Table No. 1—Fusibility of Coal Ash

State	District or Bed	Softening Temp. of Ash °F.	Analysis of Dry Coal % Ash	% Sulphur
1. Alabama	Mary Lee (Big)	2,830	9.90	.74
	Nickel Plate	2,620	4.73	.75
	Black Creek	2,560	2.73	.82
2. Indiana	Clinton	2,280	8.50	1.26
	Clinton	1,980	10.49	3.65
3. Kentucky	Elkhorn	2,500	4.02	.71
	Western	2,010	10.82	3.94
4. Ohio	Freeport	2,200	7.42	1.99
	Freeport	2,150	8.23	3.03
	Kittanning	2,600	11.13	.72
	Kittanning	2,510	6.31	1.70
	Kittanning	2,350	8.09	2.34
	Kittanning	2,090	8.33	4.10
	Kittanning	2,010	12.52	5.33
5. Pennsylvania	Pittsburgh	2,430	6.38	1.15
	Pittsburgh	2,100	7.24	2.19
	Freeport	2,470	7.25	1.52
	Freeport	2,270	7.52	2.35
	Kittanning	3,010	5.37	.68
	Kittanning	2,210	7.36	2.26
6. West Va.	Fayette Co., Sewell	2,470	3.82	.89
	McDowell Co., Pocahontas	2,330	5.24	.64
	Mercer Co., Pocahontas	2,580	4.06	.53
	Marion Co., Pittsburgh	2,230	6.10	.81

tions, however, and cannot altogether be relied upon. Other attempts to draw conclusions from analyses of either the coal or the ash itself have not proved successful. The safest course is, therefore, to obtain the fusion point by direct test.

Fig. 1. shows a chart which the writer has found very convenient for use in this connection. On this a whole year's run can be recorded on one sheet presenting a very clear picture of the state of affairs.

The coal used is entered as a line on the top part of the sheet, at a height corresponding to the softening point of its ash.

The next item to be determined is the blast temperature.

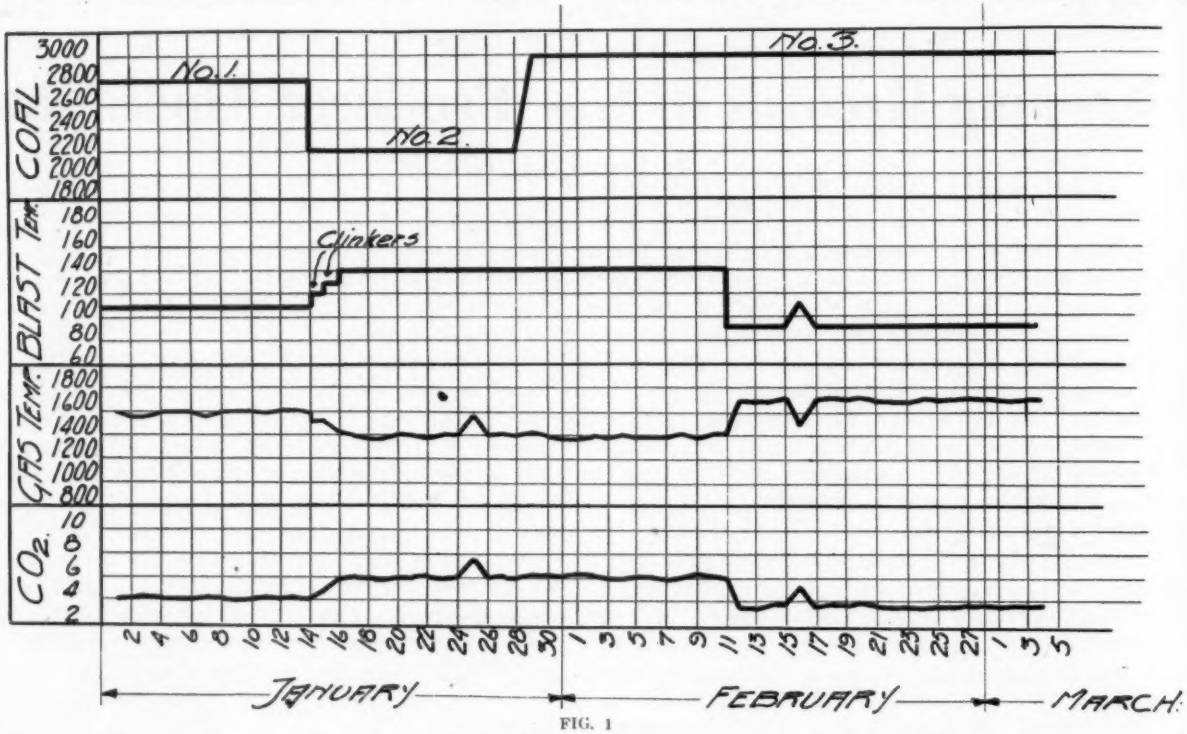


FIG. 1

By gradually lowering this temperature (and thereby the amount of steam carried to the fuel bed) until clinkers begin to appear, the critical temperature for each class of coal can be found. The results of these tests are kept for reference, and will show the most advantageous conditions under which any class of coal may be gasified in any given producer.

The blast temperatures as actually observed in the plant are plotted on the chart shown in Fig. 1.

The best possible gas is not obtained by merely supplying the producer with the minimum amount of steam consistent with clinker free operation. The height and other conditions of the fuel bed here play an important part. This, however, influences the temperature of the exit gases in such a manner as to make measurements of the fuel bed superfluous as an item in the record.

This co-ordinates the gas temperature and the analysis of the gas and these form the last two items to be plotted on the chart. As will be seen from Fig. 1 the CO_2 content only is recorded. This is done to avoid confusion, and is justified by the fact that the CO_2 content gives a fairly good indication as to the quality of the gas. If preferred, the heating value of the gas may be plotted instead.

On the chart here given as an example the performances for two months' run have been recorded. Up to the 14th of January coal No. 1. having an ash with a softening point of 2800 deg. F. is used. A blast temperature of 110 deg. F. is maintained. With a gas temperature of slightly less than 1600 deg. F. the CO_2 is kept at and above 4 per cent.

On the 14th of January the coal is changed to one having an ash fusible at a much lower temperature. It is, therefore, necessary to increase the steam in the air supply. As will be seen this is done in three successive stages until 140 deg. F. is reached. Both at 120 and 130 deg. F. clinkers appeared. The rise in blast temperature lowers the gas temperature and also increases the CO_2 content of the gas. For the producer under consideration this constitutes the best results obtainable with coal No. 2., and a glance on the chart will show from day to day if maximum efficiency is maintained.

On the 25th of January there is a break in the line, the CO_2 suddenly jumping up to over 7 per cent. There is no change shown in the blast temperature, but the gas temperature has gone up to 1600 deg. F. This indicates a change in the fuel bed condition, for which the operator is to blame. A bed too shallow or excessive blow holes will make the chart look as shown on this day.

Between January 29th and February 11th a condition exists which would only be possible in a plant where a chart of this kind is not kept. On January 29th the coal is changed to No. 3. with an ash softening point of 3,000 deg. F., but the blast temperature is still kept at 140 deg. F. This means that no benefit is derived from the better quality coal. If the general characteristics of coal No. 3 are not known,

and no record is kept the only fact evident to the manager is that no clinker trouble is experienced with a blast temperature of 140 deg. F.

But the chart immediately shows the unfavorable condition existing by not giving a lowering of the blast temperature line corresponding to the rise in the coal line. The change that should have been made on January 29th is shown on February the 11th. The CO_2 line is pushed down below 4 per cent, where it belongs for this class of coal.

The trouble occurring on February 16th is caused by the rise in blast temperature.

The relation between the various temperatures and the CO_2 content of the gas given in the accompanying chart is quantitatively correct for one plant only. The relations found to exist in other plants will depend upon the type of equipment used, the placing of pyrometers and thermometers, depth of ashes over the blast hood, etc. It is, therefore, necessary to make the chart express the experience in each individual plant, and before the desired equilibrium is found a certain amount of experimentation will have to be done. The experience gained by this trial will, however, be recorded on the chart, and will form the basis for definite instructions as to future operations.

The system has its limitations. It will not, for instance, show if maximum benefit is derived from the equipment available. But computation of this feature is so easily made, separately, over longer periods, and would be confusing if made part of a daily record.

The place for this chart is on the plant manager's desk. It will show him at any time the conditions existing in his producer plant, and it will place him in a position to answer questions when complaints on the gas are reported from the tank. It will enable him to accept or reject suggestions for change in coal.

But, above all, the chart furnishes the man in charge with a perpetual record of very valuable producer experience in his own plant, and, with modifications, in other plants.

The Frosting of Glass

By Dr. Friedrich Spate

The frosting of glass depends on a roughening of the surface of the glass, caused by non-uniform removal of individual particles of glass, and can be done by mechanical or or chemical means or by the combination of both methods on one or both surfaces of the glass object.

1.—Frosting of Glass by Mechanical Means

This is done by the action of sand on glass. If sand is allowed to fall through a tube from a suitable height—about 25 to 30 meters—on a glass object with a plain surface, the surface of the glass is gradually shattered, small fragments of glass are broken loose from the surface of the glass, while the glass in the inside remains intact. If a strong blast of air from a blower is conducted through a short tube which throws the entrained sand on the glass with great force, the frosting action is accelerated very considerably.

In the frosting process using the sand blast, the physical constants of the glass, "compressive strength," plays a secondary part. There is always a great difference whether glass, a glass cube for example, is uniformly pressed in a die in which the pressure is transmitted uniformly throughout the entire cube and in which at the critical pressure the entire glass cube is shattered or whether, as with the sand blast, the projected sand exerts continually repeated impacts on the glass, in which only the top layer of the glass struck is shattered by short impacts, until finally by this repeated process the shattering of the surface of the glass is accomplished. The brittleness of the glass is determinative for the action of the sand blast process and is measured by the work that must be done on a material to destroy it by impact[1]; as a measure of the resistance there is assumed the total amount of impact work per cubic centimeter until destruction. This "merit figure," measured in kilograms per square centimeter, is considerably smaller than the elasticity of compression. The ratio of elasticity of compression to the merit figure gives the brittleness number for a glass. The brittleness number differs greatly for different glasses, lowest for borosilicate glasses, highest for lead silicate glasses, and the latter glasses are the easiest to shatter by the action of the sand blast. It is worthy of note in the brittleness investigations by means of hammer blows on a glass cube, that surface cracks form first which in the beginning extend one millimeter or more or less inside the glass, therefore the action is similar to the influence of sand grains which are hurled with force against the glass.

The cracks formed are minute, and on the enlargement of the cracks under the action of the sand, small splinters of glass are broken out with the occurrence of concoidal fracture. The surface of the glass is non-uniformly broken, fractured. The type of the fracture of the surface of the glass depends on the grain size of the sand used; the coarser the sand the coarser is the fracture. With normal frosted glass, individual cavities with diameters up to about 0.08 millimeters were determined by means of the micrometer ocular. Further, the glass is attacked most strongly with a blast angle of 90 degrees, while with an acute angle of blast the sand grains slide along on the hard surface without carrying away considerable amounts of glass by grinding[2].

Fig. 1 shows a lead glass, frosted with white glass sand with a grain size of 0.3 to 0.6 millimeters, in plan view, and Fig. 2 in cross section. The great shattering of the surface of the glass may be seen. Observation of the cross section shows how thin the roughened layer of glass is in comparison with the glass object which itself is thin (about 0.8 mm. thick). By the use of coarser sand of 0.5 to 1.5 millimeters in diameter, the frosting is coarser and less pretty; also the

Sprechsaal, Vol. 59, p. 6-9. Translated for GLASS INDUSTRY.
[1]Föppl, Sitz.-*Ber. Munich. Ak. Wiss.*, No. e. p. 505, 111.
[2]W. Kaempfer: Leistung von Sandstrahlgebläsen; *Stahl und Eisen* 1923, p. 425.

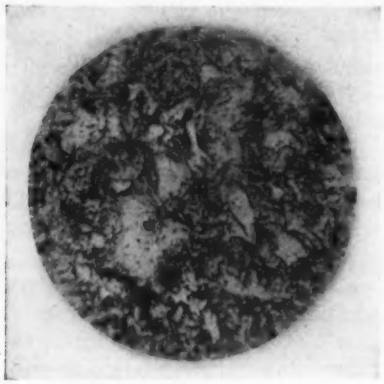


FIG. 1. FROSTED WITH SAND BLAST. PLAN. MAGNIFICATION 100.

FIG. 2. FROSTED WITH SAND BLAST. SECTION. MAGNIFICATION ABOUT 20.

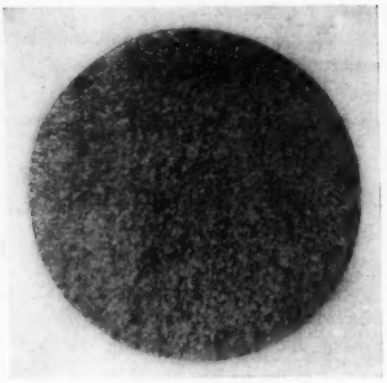


FIG. 3. CHEMICALLY FROSTED, GOOD. PLAN. MAGNIFICATION 100.

use of very coarse sand results in large breakage with thin walled glass objects. Experiments on the frosting of glass first with very coarse and then with very fine sand showed no advantage as compared with the single frosting with sand with the grain sizes mentioned above. The frosting required about 30 to 40 seconds.

II.—Frosting by Chemical Means

The etching of glass depends on the action of *free* hydrofluoric acid on silicates. Side reactions take place here on which the effect to be obtained depends. The chemical conversions take place principally according to the following formulas:

I. $aNa_2O.bCaO.cPbO.6SiO_2 + xHF =$

$$\underset{\text{soluble in water}}{2aNaF} + \underset{\text{insol. in water}}{bCaF_2} + \underset{\text{slightly soluble in water}}{cPbF_2} + \underset{\text{forms gas}}{6SiF_4} + \frac{x}{2}H_2O$$

II. $3SiF_4 + 3H_2O = \underset{\text{soluble in water}}{2H_2SiF_6} + \underset{\text{soluble and insoluble in water}}{SiO_2.H_2O}$

III. $H_2SiF_6 + 2NaF = \underset{\text{soluble in water}}{Na_2SiF_6} + 2HF$

The presence of free hydrofluoric acid is always a stipulation. Instead of sodium the other alkali metals, even the ammonium group can be used, instead of calcium the other metals of the alkaline earth group can be used.

If gaseous hydrofluoric acid is allowed to act on glass and the resultant coating is not removed, the salts that form can be recognized; under the microscope there are plainly seen small crystals of different form, to some extent also double refracting crystals. It should be remarked that of the salts that may form in the frosting process, potassium silicofluoride and calcium fluoride crystallize regularly, lead silicofluoride monoclinic, lead sulphate rhombic, sodium silicofluoride hexagonal.

If dilute hydrofluoric acid acts on a silicate glass, the products of the reaction are dissolved out; the glass is attacked of course, but *bright etched* especially with the occurrence of mechanical aid in the form of rinsing for the removal of the products of the reaction. Frequently an acid, for instance sulphuric acid, is also added to the bright etching bath for the rapid removal of the salts formed. As in the glass no special orientation is preferred by the non-crystalline substances, uniform wear (corrosion) takes place, while with crystals, in which certain characteristics are developed in a certain direction, symmetrical etched figures can form[3]. On the principal mentioned acid polishing depends, which is frequently used for polishing previously cut glass objects. In order to obtain a good polish repeated action of the acid, interrupted with repeated rinsing with water, is necessary. This will be gone into later.

If there is used concentrated hydrofluoric acid or dilute hydrofluoric acid in the presence of alkali fluorides, in which likewise the concentration is important, or if gaseous hydrofluoric acid is allowed to act on glass, the products of the reaction are deposited on the surface of the glass so that in places no further action of the hydrofluoric acid can take place, the glass is in parts attacked further by the hydrofluoric acid and in parts is not, and thus there is a roughening of the surface of the glass, a shattering as with the sand blast frosting[3]. If glass has been frosted chemically, is carefully removed from the frosting bath and carefully rinsed off, there is found on the surface of the glass a thin layer consisting of the salts mentioned above. However these adhere loosely to the glass and can be readily removed by stronger rinsing with water or with the aid of a brush whereupon the frosted surface of the glass is visible. At this point there may be encountered the assertion[4] which is still found frequently even in the recent literature on glass, that the frosted effect obtained chemically is caused by insoluble substances of crystalline or amorphous structure which have precipitated on the glass during the frosting action and adhere there firmly. This assumption has proven to be incorrect. In no case could the author prove the presence of crystals on chemically frosted glass surfaces after their thorough cleaning, and which one would have to recognize frequently by their double refraction. As a proof that the matte effect produced by chemical frosting of glass depends only on a roughening

[3]See also: E. Tammann: "Ueber die Gläser als unterkühlte Flüssigkeiten" Glastechn. Ber. Vol. III, 1925, No. 3, p. 85.

[4]F. Reinitzer: "Ueber das Mattätzen von Glas" Ber d. Oesterr Chem Ges. 1886, p. 67.—J. B. Miller: Die Glasätzerei, 1910, p. 2—F. E. Fisher: Das Gesamtgebiet der Glasätzerei, 1892, p. 2.—R. Dralle: Die Glasfabrikation, 1911, p. 102.—G. Schott: Herstellung und Eigenschaften-lichtzerstreuender Gläser; Licht und Lampe, 1925, No. 1, p. 3.—L. Springer: Die Fortschritte der Glastechnik in den letzten Jahrzehnten, 1925.—L. Vielhaber: Zur Fluorfrage in der Emailindustrie; *Keram. Rundschau* 1924, No. 51, p. 767.

FIG. 4. CHEMICALLY FROSTED. GOOD. SECTION. MAGNIFICATION ABOUT 20.

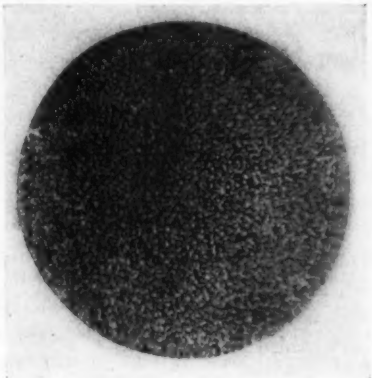


FIG. 5. CHEMICALLY FROSTED. TOO WEAK. PLAN. MAGNIFICATION 100.

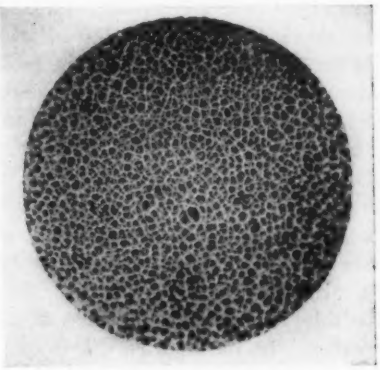


FIG. 6. CHEMICALLY FROSTED. TOO GLASSY. PLAN. MAGNIFICATION 100.

of the surface and not on the deposition of insoluble products, there must be considered, aside from the microscopic proof, the fact that the chemically frosted glass surface does not change on treatment with strong acids (aside from hydrofluoric acid) or alkalies using heat. Deposits, even silicic acid, would then have to dissolve and the appearance of the frosted surface would have to change. Many times on observing a chemically frosted glass surface one doubtless sees crystal structures; however these are only the contours that are caused by the crystals mentioned above which have been worn away by the etching process and on which the hydrofluoric acid could act further; on cleaning the glass the crystals themselves were removed, the contour of their shapes remains.

Fig. 3 and 4 show normal chemically frosted glass in plan and in section; we see the shattering of the surface of the glass, which however is less coarse than that caused by the sand blast. The fracture is finer grained than that obtained with the sand blast; the diameter of the individual cavities amounts to 0.005 to 0.01 millimeters. The fractured layer is again very thin. Determinations of the loss of weight suffered by lead glasses and alkali-lime-silicate glasses on frosting gave 60-70 milligrams per 100 square centimeters of glass surface.

To a certain extent one may obtain a certain frosted effect according to the choice and concentration of the etching medium. Hydrofluoric acid in the presence of ammonium salts gives the coarsest matte, the presence of potash salts the finest matte.

Each glass has its specific frosting bath, that is, the different types of glass act differently according to the different frosting baths, especially as regards the concentration. Alkali-lime-silicate glasses are in general most easily attacked by hydrofluoric acid, boro-silicate glasses most difficultly attacked. Also with one kind of glass a prettier matte can be obtained than with another. Thus we know that lead glasses give a pretty matte easier than alkali lime silicate glasses. One must find out experimentally the most favorable composition of a bath for obtaining a certain matte. In a matte etching bath with a very slight content of free hydrofluoric acid, in the presence alkali fluorides, the matte is very weak, fine (Fig. 5), not as coarse as Fig. 3 for example; with increasing free hydrofluoric acid content the matte becomes denser in transparency and whiter in appearance. After the optimum is attained with a certain hydrofluoric acid content, the matte becomes glassier in appearance with further increasing hydrofluoric acid content.

The cause of this phenomenon is to be sought in the fact that with increasing acid content the wearing action of the hydrofluoric acid comes into action. There takes place first the specific matting or glass roughening process; then the free hydrofluoric acid present acts on the fractured surface and a further corrosion takes place, especially of the sharp points and edges. Such a frosted surface which has been produced by the action of very much hydrofluoric acid contained in the frosting bath, is entirely different from the original matte (Fig. 3 and 6); the fractures are more rounded and the glass shows a more honeycombed structure. Such a glassy frosting is desired for many purposes, for example the so-called "silky matte" for automobile headlight lamps. Instead of producing such a matte in *one* bath, one may start from the ordinary matte and subsequently treat the frosted layer with dilute hydrofluoric acid alone, so that one likewise gets the eating away of the points and edges that has been mentioned and likewise obtains a glassy matte. If this action of aqueous hydrofluoric acid is repeated frequently, finally the frosting can be almost completely removed; this is the so-called "bright burning" of glass which process corresponds in principal to acid polishing and in regard to which it should be remarked that glass previously frosted chemically even by very frequent repeated action of hydrofluoric acid never receives the brilliancy of the fire polish. The explanation for this, that in bright burning and in acid polishing especially the inequalities are removed and the fractures inside the glass are not increased, is to be sought in the fact that an acid bath is used of such a composition that no roughening, frosting of the surface of the glass, but a wearing away is caused, while the products of decomposition are dissolved out, further that the liquid plays especially on the projecting places which are always readily subjected to fresh liquid while in the cavities this liquid frequently remains for a rather long time and finally no longer acts.

Aside from the chemical composition, the length of time for the action and the temperature of the frosting bath exert an influence on the matte effect. Frequently one may con-

veniently add to the frosting bath an indifferent substance, for example barium sulphate or meal, which acts as a thickener the same as sponge; the substance to be frosted is simply dipped in the liquid; on drawing it out the thick paste adheres to the glass object and the frosting action continues further. If the chemical frosting is repeated using a normal frosting bath (as contrasted with the strong acid bright bath mentioned above) the matte effect is intensified considerably, while at new spots at which no fracture could take place in the first frosting as a result of the deposits, the fracturing process proceeds. With the second, at most with the third frosting, the optimum of the matte effect to be obtained with the frosting bath in question is attained generally, that is, further repetition of the frosting process gives no further intensification of the matte effect. Fig 7 shows a glass surface frosted twice chemically. One does not see any principal difference between the glasses frosted chemically once and twice. Nevertheless it is astonishing that the fracture has become more uniform, that is, by reason of the second frosting even those spots that were not uniformly roughened the first time, have been subjected to the frosting process.

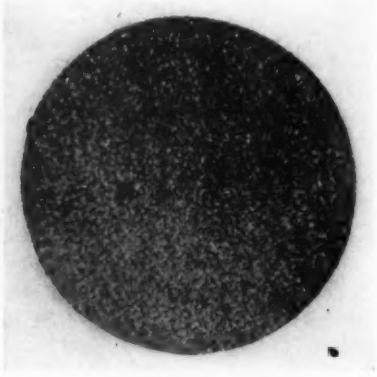


FIG. 7. CHEMICALLY FROSTED TWICE. PLAN. MAGNIFICATION 100.

III.—Combined Method of Mechanical and Chemical Frosting

A normal coarse sand blast frosting is first put on the object to be frosted, by mechanical means, using the sand blast. The coarse matted object is subsequently frosted by the ordinary chemical frosting method. There is obtained a very intensive snow white matte. The effect is to be explained in that the fracture surfaces of the first coarse matted object are themselves frosted again by the second chemical frosting. Therefore the two frostings are cumulative and give the beautiful effect mentioned. If the frosting is done first chemically and then with the sand blast there will likewise be an increase in the matte effect as regards transparency but no especially pretty effect in appearance. The first mentioned double frosting must not be confused with the method of putting decorations on glass by the treatment of parts that have been frosted by the sand blast with hydrofluoric acid and protecting certain parts by a coating that resists hydrofluoric acid. By this subsequent treatment with hydrofluoric acid the eating away of the sharp points and edges mentioned above takes place but not at the covered parts; by this there is obtained a brightening, or glassiness, of the roughened surface, while according to the method mentioned a dense intensive matte is obtained. Fig. 8 shows in plan a glass surface frosted twice by the first mentioned method. The original very coarse fracture can no longer be recognized sharply, the surface is more uniformly attacked than in Fig. 1.

IV.—The Fracture of the Surface of the Glass by the Action of Glue on Glasses Frosted Chemically or Mechanically

This method, which is not a true frosting process, but likewise signifies a roughening of the surface of the glass, should be mentioned here for the sake of completeness. If on a glass surface, preferably one that has been frosted according to one of the methods mentioned, there is placed a solution of gelatine, glue, isinglass etc., and it is allowed to dry in a hot place, the coating applied draws together; as it adheres firmly to the glass, on drawing together it breaks rather small pieces of glass from the surface and there forms on the glass a typical pretty pattern, the so-called "ice plant glass." According to the type of the original frosting, that is according to whether the glass was originally coarsely or finely matted, the ice plant pattern occurs coarser or finer. As the mentioned kind of fracture of the glass influences the breaking strength of the glass, it has been used up to the present only for thick glasses.

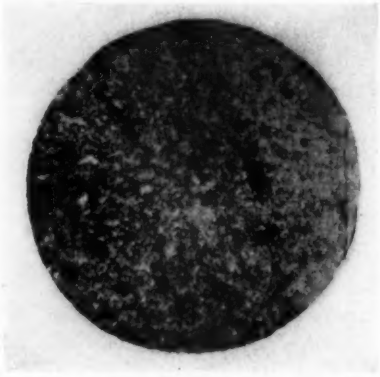


FIG. 8. FROSTED WITH SAND BLAST AND CHEMICALLY. PLAN. MAGNIFICATION 100.

V.—The Importance of Frosting in Light Technology

The purpose of the frosting is to protect the eye by diffused dispersion of the light from the bright action of the luminous incandescent object, for example direct sunlight, the incandescent lamp filaments or even the arc lamp, which is unpleasant and injurious to the eyes. For this reason—next to opaque glasses—the frosted glasses play an important part in the technology of illumination, especially because frosting is such a simple process that it can easily be applied to the finished glass products.

Through glass that is not frosted the light enters the eye of the observer without interruption, he sees the sun, the luminous metal filament of the incandescent lamp, while with well frosted lamps the wire, and with a frosted window pane the sun, is no longer visible. The rectilinear propagation of

the ray of light suffers a diffraction at the frosted glass wall as it generally does not strike the frosted obstacle at an angle of 90 degrees. Besides the phenomenon of total reflection may occur. The deflected ray of light in this case is thrown back in the interior of the glass by the smooth side turned from the light, or enters the glass at a right angle and suffers total reflection on the frosted surfaces turned from the luminous object. In the case of an incandescent lamp the path of the ray of light may be a rather long one until it leaves the lamp at some point. As a result of the deviation experienced, the ray of light no longer seems to the observer to come from the luminous body. If on account of the roughened surface of the glass this deviation of the ray of light takes place in very many places, all rays of light that come from the luminous body are broken irregularly, and finally the luminous body, for example the metal wire, is no longer seen. The stronger the matte effect the more the wire disappears and for example one sees an incandescent lamp as a luminous ball or at least as a white luminous spot. If the frosting is not sufficiently strong, only a part of the light is dispersed by diffusion; between the rough spots on the surface of the glass however individual rays of light are able to pass bent not at all or but little. Then with partial diffuse distribution of the light one still sees the incandescent filaments. If rays from the sun fall on a well frosted sheet of glass, the observer under the sheet of glass no longer sees the sun itself but instead a uniformly illuminated sheet of glass.

Aside from the dispersion of light an absorption of light also takes place. All glass, even colorless glass, absorbs light to a greater or less extent. If a sheet of glass is frosted, the light no longer passes through the glass in the shortest way but on account of the diffraction and total reflection travels a longer path in the glass, so that greater absorption results. Anyone who uses frosted glass must therefore always take into consideration the loss of light caused by the frosting.

In the measurement of the light absorption and the degree of dispersion of light in incandescent lamps the matte effect often proves very different because many factors exert influences that cannot always be controlled: variations in the composition of the glass, surface properties of the glass, temperature fluctuations, duration of the glass erosion process in frosting, variations in the composition of the frosting bath, quality of the frosting sand and others. Besides the type of lamp, that is the strength of the light and the distance of the luminous body from the glass wall exerts an influence.

The losses of light caused by a frosted bell depend—as mentioned—on the path followed by the light in the glass and consequently on the extent of the fracture of the surface of the glass.

In general we can state that the least loss of light takes place with single chemical frosting. With double frosting, chemical only or with sand blast and then chemically, the loss in light increases considerably. The losses of light determined photometrically vary with incandescent lamps between 2.5 and 14 per cent, referred to clear glass as zero, according to the type of the frosting, in which the greatest loss of light measured in incandescent lamp bulbs was determined in those that were frosted inside and outside in the intensive manner.

A quantitative determination of the dispersion action of opaque or frosted transparent mediums is possible according to the method of L. Bloch[5], in which by means of an objective an image of the source of light of suitable size is thrown on a plane, the medium that causes the diffuse distribution of the light, for example a frosted bell, is placed in between, and the variation of the illuminating intensities is measured at a number of points on one or several diameters of the image by means of the Bechstein luxmeter, so that one obtains a distribution of the brightness. If one takes the average value of all measurements taking into consideration the size of the surface of the medium investigated and divides by the maximum value, there is obtained the degree of dispersion in per cent. In this manner it was determined for frosted incandescent lamp bulbs that according to the kind of frosting, the light dispersion amounts to 11 to 45 per cent (11 per cent with single ordinary chemical frosting, about 45 per cent with strongest frosting on both sides). In general it can be said that the sand blast frosting is more intense than chemical frosting. With incandescent lamp bulbs of opal glass the dispersion amounts to about 80 per cent.

The matte effect does not apply to the dispersion of light caused by opal glass bells, in other words, a glass that is roughened only on the walls cannot disperse light as much as a glass that causes the dispersion of light through its entire mass.

Conclusion

The frosting of glass does not depend on the deposition of crystalline substances on glass, but on a roughening of the surface of the glass. Different methods have been described according to which a smooth glass surface may be roughened: 1—chemically with hydrofluoric acid; 2—mechanically with sand blast; 3—by the combination of chemical and sand blast method; 4—by the action of glue on glass frosted chemico-mechanically. On account of the roughened surface of the glass a deflection of the rays of light takes place so that the light coming from the luminous body is dispersed with diffusion. The amount of light dispersion caused by this deflection and the light absorption in connection with it were measured. It was determined that even the most intensive frosting did not reach opal glass in the light dispersion effect.

[5] Licht und Lampe, 1925, p. 39.

To Publish Arbitration Guide

The American Arbitration Association, 342 Madison avenue, New York, whose activities are devoted to encouraging the practice of settling business and personal disputes of all kinds by arbitration rather than through the courts, and whose efforts are meeting with excellent success, is preparing to issue an official guide to civil and commercial arbitration as developed and practiced by American business and professional men. Some two hundred trade associations and chambers of commerce have cooperated to make possible the publication of this official handbook which is planned for issue next fall. This directory will enable any one to ascertain at a glance what facilities exist for the settlement of disputes, what laws or decisions affect the arbitration, who are available as arbitrators, etc. Meantime the association will gladly furnish information on the various phases of arbitration to any one interested.

New Glass Transmits Ultra-Violet Rays

By Fred M. Locke*

A new glass for transmitting ultra-violet rays, which is a radical departure in composition from any of the different kinds of glass now upon the market has been developed and patented[1] by Fred M. Locke Research Laboratory.

It is well known that ordinary plate and window glass and other glasses absorb a greater part of the ultra-violet rays, and that below a wavelength of 300 Mu they do not transmit any appreciable percentage. It is, however, below a wavelength of 300 Mu, down to 270 Mu that the greatest healing power of these rays is found. However, up to the present no glass has been found, with exception of fused quartz, that will transmit at these wavelengths. As is well known, the cost of fused quartz is prohibitive for most uses.

This new glass when in relatively thin pieces, will equal fused quartz in its transmission, transmitting as low as 200 Mu and in pieces up to one-half inch thick will transmit far into the ultra-violet.

The cost of this new glass is only slightly higher than ordinary plate or window glass. It can be melted in the ordinary tank or pot, and is exceptionally clear and transparent, equal to that of the best optical glass.

It has also a number of other interesting characteristics, one being its low expansion, about that of the best chemical glass i.e., 0.0000035. It also has the property of insulating electricity at a high temperature, up to the melting point of the glass itself.

In its simpler form this glass contains only four ingredients and is substantially free from the alkalies, soda, potash and lithia.

The following table gives number of raw batches which will produce this glass:

	1	2	3	4	5	6	7	8
Silica	30	37	40	34½	35	25	43	50
Alumina, hydrated	20	25	18	16	15	35	25	30
Boric acid	40	25	17	14	28	15	20	—
Fluorspar	10	10	8½	7	7	25	12	20
Magnesium carbonate	—	3	—	—	—	—	—	—
Lead oxid	—	—	16½	28½	15	—	—	—

In the following table the glasses A to H inclusive are glasses calculated from the batches 1 to 8, inclusive, of the foregoing table. The glass I is an additional glass of a similar nature:

	A	B	C	D	E	F	G	H	I
Silica, SiO_2	42	50	50	42	44	34	55	57	68
Alumina, Al_2O_3	20	20½	13	13	12.6	32½	22½	23	15½
Boric oxid, B_2O_3	30	19	12	9	19.4	13½	14	—	10.3
Lime, CaO	8	8	6	5	5	20	8½	20	5.7
Magnesia, MgO	—	2½	—	—	—	—	—	—	.25
Sodium oxid, Na_2O	—	—	—	—	—	—	—	—	.25
Lead oxid, PbO	—	—	19	31	19	—	—	—	—

All of the above glasses have a low silica content, not exceeding 70 per cent and this content may be reduced as low as 25 per cent to obtain some of the properties of this type of glass.

It will be noted that all the batches as well as the glasses contain large amounts of alumina. In the examples given, the finished glasses contain from 12.6% to 32.5% of alumina. However, it has been found that some of the properties of these glasses may be secured by providing an alumina content of 10% to 35% in the finished glass. Alumina has not heretofore been used in low-expansion glasses in large amounts, because when combined with an alkali it will produce large expansion or make the glass so hard that it is impracticable to work. In this type of glasses the alumina appears to act as a flux and increases the workability. It stops the danger of crystallization, increases stability, and tends to make low expansion.

It is evident that the compositions given are radical changes from the usual glasses. Heretofore the use of fluorspar in any appreciable amounts in glass was for the purpose of obtaining opaque or opal glasses, and it was known that by the use of such material in large amounts the pots or refractories used were attacked to a marked degree. It was found, however, that the use of fluorospar together with large amounts of alumina resulted in glasses that were exceptionally clear and transparent, and that the fluorspar did not attack the pot as much as would the ordinary type of alkali glasses.

Experiments have proved that the best results are obtained when using calcium fluoride as the principal fluxing material. However, other fluorides or other compounds of the alkaline earth metals may be employed, particularly if it is not desirable to obtain transparent glass.

In some of the batches the boric oxide has been partially replaced by lead for the increasing of the fusibility and workability of the batch, while at the same time the tendency to devitrification has decreased. Lead also tends to better the insulating properties of these glasses. Instead of lead, barium may be used in some cases.

A further advantage of this type of glass is high stability against the attack of steam, water, acids and atmospheric conditions and a fair stability against the action of alkalies. This latter property is unusual, as glasses heretofore made with substantially no alkali content are readily attacked by alkaline solutions, especially under the action of heat.

This type of glass may be melted or worked in an ordinary pot or tank. It is plastic enough through a considerable range of temperature to allow it to be pressed or blown into shape in the ordinary manner.

While this glass was originally developed as a material for electrical insulators, spark plugs and radio power transmitting tubes, it was found that it also has the power of transmitting ultra-violet rays in large percentages. As an example of the batches shown in the above table, batch No. 1 will when made into glass about 2 millimeter in thickness, transmit as low a wavelength at 230 Mu. This glass is composed, as will be noted, of only silica, boric oxide, alumina and fluorspar. Other glasses can be made which will transmit further than this, down to 200 Mu.

* The Fred M. Locke Research Laboratory, Victor, N. Y.

[1] U. S. Patent No. 1,529,259.

The Testing of Milk Bottles

And the Effect of Design of the Bottle Head Upon Breakage

By F. W. Kouwenhoven*

In 1923 the author was asked to investigate the increasing breakage of bottles in a Baltimore dairy. Engineering methods of test were devised, including compression, hydrostatic, tapping, temperature, and impact tests. It was found that bottles had to follow the rules of casting, involving the use of well-filleted corners and the avoidance of abrupt changes in section. A "supported curve" type of bottle head has been designed and shown to be definitely superior to earlier types.

The problem dealt with in this paper was originally presented to the author early in 1923 by a Baltimore dairy whose bottle breakage had increased considerably, even though they were operating a new and modern plant. He was asked to determine whether any eastern bottle manufacturer made better bottles than the one from which they purchased their supply, and incidentally to reduce breakage.

The problem of reducing milk-bottle breakage is peculiar in that it is desired to use the bottle many times. Coupled with this repeated use is the soaking in washing-powder solutions, heating to a sterilizing temperature, cooling to the temperature of refrigerated milk, the cycle from dirty bottle to a filled, capped, and chilled container averaging approximately forty-five minutes in the modern plant.

A careful search of engineering literature failed to reveal any data on either the design or the testing of milk bottles. It was therefore necessary to devise tests. All test work has been confined to the quart bottle only, since approximately seventy-five per cent of the output of the average pasteurizing plant bottling milk goes into quart bottles, and ten per cent into pints, half-pints, and jars while the remainder goes into cans. By far the largest breakage is among quarts.

Mechanical Tests

The first test employed was the ordinary compression one using a universal testing machine with the bottle in a vertical position. The weakest bottle tested withstood a compression load of 2,400 lb. before fracturing, while the strongest withstood a load of 6,200 lb. The average of some thirty bottles of various manufacture was 4,250 lb. A similar variation in strength is met with in practically all strength tests of glass bottles. When one thinks of the present methods of manufacturing; with the continuous tanks of molten glass, operated for months on a stretch, or until something fails about the tank itself; where the raw ingredients are shoveled into the "dog house" at the one end of the furnace and the liquid glass is allowed to flow out at the other end without stirring or otherwise mixing, it is surprising that the variations are not much larger.

It is evident that never in the ordinary life of a milk bottle is it subjected to any thing like a compression load of 2,400 lb., and the variations are so large as to make comparative results difficult to obtain. Therefore the vertical compression test was discontinued.

The next test attempted was the side compression test. In this test the bottle to be tested was placed between two other bottles and the three were stacked, so that the bottles themselves were horizontal, between the heads of a testing machine. This method was patterned after the method of testing ball bearings in compression. In this test, as in the ball-bearing one, the center specimen will fracture when its ultimate load is reached. This test was discontinued after ten bottles were broken, since the average load required to fracture the ten was 978 lb, and the variation was large.

A compression test of the bottle head only was tried. In this test the head of the specimen was fractured by placing it between two 1-in. steel blocks mounted on the heads of the testing machine. This test proved useful in determining that a "supported curve" type of head (Fig. 2) was far stronger than the common type (Fig. 1). It was necessary to place the specimen each time in the same relative position

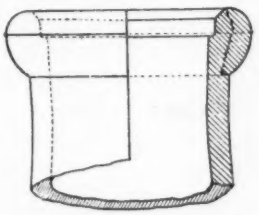


FIG. 1. UNSUPPORTED CURVE.

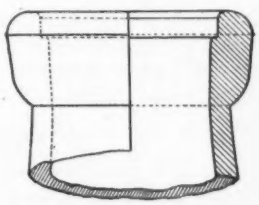


FIG. 2. SUPPORTED CURVE.

since one make of bottle would prove stronger if the die marks were in the horizontal plane and other makes when the die marks were in a vertical plane. The average load required to fraction 50 specimens with the supported-curve type of head was 1,350 lb., and for the same number with the unsupported-curve type the average was 1,125 lb. These specimens were of various manufacture.

Hydrostatic Test

The so-called "internal hydrostatic test" was the next devised, since it was thought possible that extreme pressures would be met with when a full bottle of milk was capped on the automatic cappers. In this test the bottle was clamped in a small fixture so that the hydrostatic pressure produced by means of an ordinary deadweight gage tester could be led to the interior of the specimen.

It was found that the average internal hydrostatic pressure required to fracture 82 quart bottles of various manufacture was 185 lb. per sq. in. The hydrostatic test has proved a very satisfactory one, since it will show up a poor distribution of glass such as thin sides, thin spots, heavy bottom, and the like.

Temperature Test

The so-called "temperature test," similar to that used by most bottle manufacturers as a test for anneal before the polariscope came into general use, was the next tried. This

* Instructor in Mechanical Engineering, Johns Hopkins University, in *Mechanical Engineering*, June, 1926.

test has proved to be anything but a test for anneal. In the modern washing machine the bottle must withstand temperature changes, both cold to hot and hot to cold. After it was determined that bottles would withstand, almost without exception, a difference of temperature from cold to hot water of over 170 deg. fahr., efforts were concentrated on the reverse test, that is, hot water to cold water. It was found that a well-annealed and well-designed quart bottle would safely withstand a temperature difference, hot to cold, of 85 deg. F. when working from a hot-water temperature of 150 deg. F. The upper temperature is important since it was found that a well-designed and well-annealed bottle would withstand a temperature difference of 88 deg. F. when the upper temperature was 130 deg. F.; while with an upper temperature of 210 deg. F. a difference of but 80 deg. was only reasonably safe. The manipulation in this test is important. The procedure was to allow the bottles under test to stand for four minutes immersed in water kept constant at the desired upper temperature and in circulation with a motor-driven stirrer. The bottle was then emptied as rapidly as possible, being handled by a pair of rubber-protected gas-pipe pliers, and was then thrust, bottom downward at an angle of approximately 30 deg., beneath the surface of the cold water and allowed to fill. This test has proved useful in the determination of the proper design of both the head and the bottom of the bottle, since a bottle with too heavy a head will crack at that point, and one with too heavy or too flat a bottom will crack there.

Tapping Tests

Attention was then turned to the dairy itself. It was found that the approximate distribution of breakage was as follows:

Chipped-neck breakage (loss of bottle due to breakage at head and at head only)..... (This item averages 40 per cent in those dairies using a fair type of unsupported-curve head)	70 per cent
All other plant breakage.....	30 per cent

The large proportion of breakage chargeable to chipped necks directed us to the type of head on the bottle then in use.

In this connection it must be remembered that a milk bottle is a *cast* shape, even though formed of a so-called gel rather than of a crystalline structure such as cast iron. It should therefore follow, as nearly as is practical, one of the chief rules of casting, namely, the use of well-filleted corners and the avoidance of abrupt changes in section.

The bottle in use at that time violated this rule, since it had both sharp edges and an abrupt change in section. (Fig. 1.)

To prove that the sharp edges at the top of the head were the cause of a large number of the chipped necks, the tapping test was devised. For this test a small motor-driven cam-operated tapping machine was built.

After several experiments the final machine carried an ordinary 4-oz. machinist's ball-peen hammer with its handle turned down so that the effective weight was concentrated in the head. This hammer was controlled by the motor-driven cam and was allowed to fall freely a distance of approximately 3 in. at a speed of 100 blows per minute so that its peen impinged upon the highest point of the head of a quart milk bottle standing beneath it. By means of a counter the number of blows required to fracture the head seriously was ascertained. By "seriously fracture" is meant either to break off a piece of glass of sufficient size, or to crack the head in some other fashion so as to make the bottle worthless. A number of tests on the bottles then in use showed that an average of 12 blows was necessary to fracture the head seriously. The typical fracture of this older type of bottle is interesting and important. The fracture took the approximate path shown by the dotted line in Fig. 1 running down along the center of the section area of the head, a large piece cracking off and resulting in a razor-like edge at the lower point. When the new head, Fig. 2, was designed, being in essence the old head with a rounded top section and a "supported curve," this fracture was never met with. In this new type of bottle the number of blows required to fracture the head seriously was well above 500. No exact average can be given, since the hammer often pulverized its way into the glass without otherwise fracturing the head.

Impact Test

To test the bottle further and to prove the necessity of the so-called "supported curve" section, the impact machine was adopted to bottle use. The ordinary impact machine is far too powerful, nor can a bottle be satisfactorily clamped thereto. Accordingly a small special impact machine was built for use in the tests. This machine carried a 7½-lb. machinery-steel ball mounted on the end of a light ball-bearing-mounted shaft. It would develop 275 in-lb. of energy when dropped from the catch position (approximately 30 deg. from the horizontal). The results given in this paper are relative only for this test, since no attempt has been made to calculate the energy absorbed in imparting velocity energy to the particles of glass when the bottle was broken. The material of which the hammer is composed was also found to be of importance. In this test it is also necessary to clamp the bottle so that the hammer will impinge upon the same relative spot on the bottle head each time. This is apparently due to the fact that bottle heads are seldom exactly circular in shape and the glass is unevenly distributed around the circumference, probably due in part to wear of mold. It was found that the average amount of energy required to fracture the heads of the older type of bottle was 52.4 in-lb. The average energy required to fracture the head of the newer bottles having the supported-curve type of head was 92.4 in-lb. for those that did fracture; while one of every four bottles could not be broken even with the 275 in-lb. of energy available.

The so-called "new" bottle was put into use in that dairy during the spring of 1924. It has proved a success in reducing breakage. The chipped neck, once forming 70 per cent of the breakage occurring in that plant, has practically disappeared. No exact breakage figures can be given for either the period before or the period after the new bottle came into use. Breakage figures are one of the hardest things to obtain in a dairy, and when obtained are probably not properly segregated and are therefore not trustworthy. It can be said, though, that a second local dairy is now using the new head on their bottles.

The Melting of Yellow Glass*

By Erich Felsner

Of all varieties of colored glass, yellow glass is the most difficult to make. It requires much attention and a special method of melting, in order to produce a glass entirely free from blisters. Although there a large number of coloring agents available for the manufacture of yellow glass, it is not easy to obtain a product of a definite color.

The following gives a number of tested coloring agents for the different grades of color. The quantities are calculated on a basis of 100 lbs. of sand. Any good glass batch can be used to give a basic glass in combination with these coloring agents.

ORDINARY YELLOW:		
Soda ash batch	Graphite	1¾ lbs.
	Charcoal	2¾ "
	Wheat flour	5½ "
	Coal	1 "
ANTIQUE YELLOW:		
Soda ash batch	Manganese	5 lbs.
	Iron oxide (magnetite)	2 "
	Sulphur	0.3 "
AMBER YELLOW:		
Potash batch	Sawdust	4 lbs.
Potash—Soda ash batch	Cadmium sulphide	6 "
	Sodium sulphide	1 "
	Sodium uranate	1.2 "
	Potassium bichromate	0.1 "
	Antimony	0.15 "
Soda ash batch	Sodium uranate	1.3 lbs.
	Antimony	0.25 "
GOLDEN YELLOW:		
Soda ash batch	Manganese	3 lbs.
	Iron oxide	1.5 "
	Tartaric acid	2 "
Potash—Soda ash batch	Charcoal	3 lbs.
	Tartaric acid	1.5 "
	Borax	1.5 "
Bottle Glass—Salt cake batch	Graphite	2 lbs.
	Manganese	5 "
or:	Manganese	6 "
	Coal	1.2 "
	Graphite	1.2 "
CANARY YELLOW:		
Potash—Lead oxide batch	Cadmium sulphide	2.5 lbs.
	Sodium sulphide	0.75 "
	Tartaric acid	1 "
	Borax	0.75 "
or:	Sodium sulphide	1 "
	Cadmium sulphide	3 "
	Flowers of sulphur	0.2 "
Potash—Soda ash batch	Flowers of sulphur	0.8 lbs.
	Cadmium sulphide	0.25 "
or:	Flowers of sulphur	1.25 "
or:	Sodium uranate	1.2 "
	Manganese	0.45 "
	Antimony	0.12 "
	Potassium bichromate	0.8 "
	Cadmium sulphide	1.25 "
	Uranium oxide	0.5 "
	Flowers of sulphur	0.35 "
Potash batch	Sodium uranate	0.375 lbs.
Opaque glass batch	Uranium oxide	1.2 lbs.
	Antimony	0.18 "
IVORY YELLOW:		
Opaque glass batch	Manganese	4 lbs.
	Iron oxide	1 "
YELLOW OPAL GLASS:		
Potash—Bone ash batch	Silver	0.10 lbs.
Potash—Soda ash-bone ash	Silver	0.11 lbs.
	Sodium uranate	1 "
	Potassium chromate	0.15 "
	Cadmium sulphide	5 "
YELLOW-BROWN:		
Soda ash batch	Manganese	3 lbs.
	Coal	3.5 "
or:	Coal	2 "
	Graphite	1¼ "
BROWN:		
Soda ash batch	Manganese	14 lbs.
	Graphite	5 "
	Wheat flour	4 "
	Birchwood charcoal	1¾ "
or:	Manganese	5 "
	Iron oxide	2 "
	Wheat flour	2 "

Besides the batches given above, there exist a number of other coloring agents with which yellow glass can be made in different tones. It is easier to obtain the right color than to melt the glass properly.

The melting process of yellow glasses differs from that of other varieties of glass. It must be conducted in a special way if good results are to be obtained. While usually substances are added to aid the fining and to cause the formation of gas, this is not done in the manufacture of yellow glass. Yellow glass foams considerably, according to the coloring matter employed, and its quantity. A thick layer of foam is formed above the molten glass, which may go over the edge of the pot. This often causes large losses of glass. The batch melts very slowly, since the heat cannot penetrate the heavy layer of foam.

This strong foaming may be prevented by the addition of fluorspar or common salt. These act well, but can only be used in limited amounts, to prevent changing the quality of the glass, and to avoid making the batch too expensive.

Usually yellow glass is made in a pot, at a low temperature. It does not foam so much under these conditions, but never becomes completely fined. Such glass may foam during changes in temperature and during working. This evil can only be avoided by a thorough melting of the glass.

Glasses colored with graphite foam the most. But even these can be made without addition of fluorspar or salt and a non-foaming glass is obtained if the melting is done as follows:

First the available cullet of the same composition as the glass to be melted is put in the pot. Even if the pot is only half full, no batch is added. The cullet is melted completely. If no more foam appears, the batch is put into the pot. Experiments to add both cullet and batch have not given satisfactory results. The batch will remain together in lumps which stick to the bottom. This makes the melting time much too long. If new batch is added to the half-melted material, while it is foaming, much gas remains occluded in the glass, which will escape during the fining process. This causes strong foaming which may cause the contents of the pot to run over the edge of the pot. In such a case it is necessary to keep the pot cool in order to prevent loss. However, only glass that is incompletely fined is obtained,

* *Keramische Rundschau.* Vol. 34, No. 13, p. 211. Translated for GLASS INDUSTRY.

and it may foam at every small change in temperature.

The additions of batch should be made only in small amounts in order to obtain a thoroughly melted glass. If a strongly foaming glass is being made, the best quantity to add is two shovelfulls at the time. Observations regarding the melting time of such glass gave the following results:

1 shovelfull in 10 minutes	5 shovelsfull in 130 minutes
2 shovelsfull in 25 minutes	6 shovelsfull in 180 minutes
3 shovelsfull in 45 minutes	7 shovelsfull in 235 minutes
4 shovelsfull in 80 minutes	8 shovelsfull in 300 minutes

This shows that with increasing quantities the melting time per shovelfull increases considerably. It is tedious to fill up a pot gradually, but this trouble should be disregarded. It is the only way to obtain a high quality, well melted glass, that does not foam during changes of temperature. The last addition of batch should take place 45 to 60 minutes before the end of the melting period. This is easily accomplished and is necessary to obtain an even color.

If small objects are being made, so that the pot contains already much glass at the beginning of the melt, it is best to add no cullet, but to wait till the pot is entirely empty.

If the melting is done as described, it is quite possible to fill up the pot to the brim and if done in this fashion there never occurs a case of foaming. It might be feared that the glass will not become homogeneous and will contain waves and lines. This, however, is never the case, since on account of the fact that the glass is foaming considerably, the glass mass is continually moving, so that the different parts are being mixed thoroughly with every new addition of batch.

The Laboratory

Valuation of Aluminum-Bearing Materials

Aluminum enters into the composition of opaque and semi-translucent glasses in connection with fluorine. In the mineral cryolite these two elements occur simultaneously, combined with sodium. Cryolite is therefore the logical material to use for this purpose, but on account of its high cost it is often partly or completely replaced by feldspar and fluorspar, which when used together in the proper proportions, introduce the same elements as cryolite, and at a lower cost. However, lime is introduced also by the use of fluorspar, and silica accompanies the aluminum of feldspar, so that the use of this combination of raw materials is somewhat restricted.

Aluminum is being used more and more in the manufacture of transparent glass, especially bottles. It prevents devitrification, lowers the coefficient of expansion, increases the tensile strength and improves the brilliancy and luster of glass. It also increases the resistance to weathering.[1]

Aluminum-Bearing Materials

The sources of aluminum for glass making are chiefly the oxide, Al_2O_3, the hydroxide $Al(OH)_3$, and the minerals kaolin, feldspar and lepidolite.

Kaolin is a decomposition product of feldspathic rocks. The pure material has the composition $Al_2O_3,2SiO_2,2H_2O$, corresponding to 39.5 per cent Al_2O_3, 46.6 per cent SiO_2, and 13.9 per cent H_2O. The water is completely expelled at 600 degrees centigrade and therefore 86.1 per cent only enters into the composition of the glass.

ANALYSES OF KAOLIN

	Per Cent	Per Cent
Silica (SiO_2)	45.78	54.20
Alumina (Al_2O_3)	36.46	32.90
Ferric oxide (Fe_2O_3)	1.36	0.29
Lime (CaO)	0.50	0.17
Magnesia (MgO)	0.04	0.13
Alkalies (Na_2O, K_2O)	0.25	0.49
Ignition loss	15.45	11.82

The feldspar group of minerals includes several species, all silicates of alumina with one or more of the bases potash, soda and lime. They may be divided into two groups, namely the potash-soda feldspars and the soda-lime feldspars.

Orthoclase and microcline, whose composition is expressed by the formula $K_2O,Al_2O_3,6SiO_2$ are the chief representatives of the first group. Their theoretical composition is SiO_2 64.7 per cent, Al_2O_3 18.4 per cent, K_2O 16.9 per cent. The potash may be wholly or partly replaced by soda. Potash-soda feldspar is usually pink in color, but may yet be sufficiently low in iron to permit its use in glass making.

The soda-lime feldspars, or plagioclases, present a series of minerals ranging from soda feldspar, albite, through soda-lime feldspars to pure lime spar, anorthite, at the other end.

Albite, $Na_2O,Al_2O_3,6SiO_2$, contains 11.8 per cent Na_2O, 19.5 per cent Al_2O_3 and 68.7 per cent SiO_2.

Anorthite, $CaO,Al_2O_3,2SiO_2$ contains 20.1 per cent CaO, 36.7 per cent Al_2O_3 and 43.2 per cent SiO_2.

The feldspar deposits occurring in various localities correspond more or less to the compositions given above. The variations are due to impurities and to mixtures of various types of feldspar.

Most of the feldspar quarried in the United States is the potash-soda type, but in some localities the soda spar albite is present. The following table gives the composition of feldspar from a number of localities.[2]

ANALYSES OF FELDSPAR

	Per Cent	Per Cent	Per Cent
Silica (SiO_2)	65.95	64.62	68.60
Alumina (Al_2O_3)	18.00	20.57	19.10
Ferric oxide (Fe_2O_3)	0.12	trace	0.14
Lime (CaO)	1.05	0.14	trace
Magnesia (MgO)	trace	2.36	0.28
Potassium oxide (K_2O)	12.13	1.94	9.03
Sodium oxide (Na_2O)	2.11	10.27	2.09

Methods of Analysis

The following outline applies to kaolin and feldspar, and can also be used when an analysis of refractory clay is desired. It is recognized that there are objections to parts of the procedure as suggested here. There are numerous ways in rock analysis, leading to the same result. In all cases the shortest method has been selected, even at the expense of extreme accuracy which is rarely required in technical analyses of this nature.

[1] For a discussion of the properties of aluminum in glass, consult THIS JOURNAL, Vol. 6, No. 4, 69-73 (April, 1925).
[2] United States Geological Survey Bulletin 420.

SILICA. Fuse a one gram sample with 5 grams of sodium carbonate in a platinum crucible. When fully fused, pour the liquid mass into a platinum dish, floating in a beaker filled with water. Transfer the crucible and the cake to a casserole, add hot water and hydrochloric acid and heat until complete disintegration. Evaporate to dryness and heat in an oven to 110° C. Take up with hot water and hydrochloric acid and filter. Evaporate the filtrate to dryness to remove the last traces of silica in solution, combine the two silica precipitates in a platinum crucible, ignite and weigh. Add a few drops of dilute sulphuric acid and sufficient hydrofluoric acid to dissolve the contents of the crucible. Heat on a sand-bath to expel all acids and finally heat to a dull red heat. Allow to cool and weigh. The loss in weight gives the silica present in the sample.

To the residue in the platinum crucible add a little sodium bisulphate and fuse. Dissolve in hot water and a little hydrochloric acid and add this to the filtrate from the silica.

ALUMINA. Add about three grams of ammonium nitrate, some hydrogen peroxide and a few drops of methyl red and heat to boiling. Add ammonia, drop by drop until the solution assumes a yellow color. Boil for a few minutes and filter at once. Wash the precipitate with hot 2 per cent ammonium nitrate solution. The precipitate contains iron, and aluminum, also titanium and phosphorus if present. The filtrate contains calcium and magnesium.

Transfer the filter paper and precipitate to the beaker in which the precipitation has been made. Add enough strong nitric acid to completely dissolve the precipitate and break up the paper with a glass rod. Add hot water, bring to a boil and add ammonia in slight excess, using methyl red indicator. Filter, wash as before, ignite and weigh as Fe_2O_3,Al_2O_3,-TiO_2,P_2O_5. Combine the two filtrates from the ammonia precipitation, concentrate if necessary and preserve for the determinations of lime and magnesia.

Fuse the weighed precipitate in a platinum crucible with five times its weight of sodium carbonate. Dissolve in 3 per cent hydrochloric acid, make up to 200 cc. in a standard flask. Pipette 100 cc. into a beaker, heat to about 90° and gas the solution with hydrogen sulphide. Expel excess with carbon dioxide gas; titrate iron with N/20 permanganate.

Calculation:

cc. N/20 $KMnO_4 \times .003992 \times 100 \times 2 = \%\ Fe_2O_3$

Return the solution after titration to a porcelain dish and concentrate to less than 60 cc. Transfer to a Nessler tube, add enough hydrogen peroxide (free from fluorides), to peroxidize the titanium fully and determine the TiO_2 colorimetrically, using a standard solution containing O.1 mg. of titanium oxide per cc. If no titanium is present, or if great accuracy is not required, this determination may be omitted.

The remaining 100 cc. may be used for the determination of P_2O_5, by addition of ammonia, which precipitates iron and phosphorus. This is dissolved in nitric acid, and the phosphorus precipitated with ammonium molybdate, which may be titrated with standard alkali and nitric acid solutions. This determination may often be omitted.

Lime is determined in the filtrate from the alumina, etc., by addition of ammonium oxalate, and subsequent weighing as CaO, or by titration with permanganate. Magnesia is determined in the filtrate from the lime by addition of ammonium phosphate and weighing as magnesium pyrophosphate. ($Mg_2P_2O_7 \times .3621 = MgO$)

Determination of the Alkalies

In a glass or agate mortar mix one half gram of the sample with one gram of ammonium chloride, then add 5 grams of calcium carbonate and mix well. Transfer to a platinum crucible, containing one gram of calcium carbonate, spread over the bottom. Carefully heat over a very small flame. After about a half hour, gradually increase the size of the flame, but avoid overheating which may cause the fusion of the contents of the crucible. The material should sinter and can then be easily removed from the crucible. The calcium carbonate on the bottom prevents the cake from sticking.

By this treatment the alkalies are converted to chlorides, the other metals to the oxides (magnesium also) and the silica to calcium silicate. This makes possible the leaching out of the alkalies with hot water. The reaction may take place as follows:

$$2\ KAlSi_3O_8 + 6\ CaCO_3 + NH_4Cl =$$
$$6\ CaSiO_3 + 6\ CO_2 + Al_2O_3 + 2\ KCl + 2\ NH_3 + H_2O$$

Besides the alkalies, calcium chloride also goes in solution and therefore must be removed.

Transfer the contents of the crucible to a casserole add hot water and heat until complete disintegration. Filter and wash with hot water. The residue should be completely soluble in hydrochloric acid.

The filtrate is concentrated and ammonium carbonate is added to remove the lime. Filter, concentrate to a small volume and add a few drops of ammonium carbonate solution to remove the last traces of lime. Filter into a casserole and evaporate to dryness. Add a few drops of sulphuric acid, 1:1, and heat until the residue in the porcelain dish is white. Dissolve in a little hot water and transfer the solution to a weighed platinum dish. Evaporate to dryness, heat in an oven to 105° and weigh as $K_2SO_4 + Na_2SO_4$.

The usual procedure is to weigh the alkalies as the chlorides. However, it has been found that in decomposing the ammonium salts, and in burning up the organic matter invariably present, some alkalies are volatilized if present as chlorides. Conversion to sulphates prevents loss by volatilization and also facilitates the removal of carbonaceous matter.

To separate the alkalies, dissolve the salts in a little hot water and transfer to a small porcelain or glass dish. Add a few drops of hydrochloric acid, and sufficient platinic chloride solution to precipitate the potash present and convert the sodium to the chloroplatinate. Evaporate to a pasty mass and add 80 per cent alcohol. Filter, wash with 80 per cent alcohol, then with 10 cc. of a solution containing 100 grams of ammonium chloride in 500 cc. of water and to which 5 grams of potassium platinic chloride has been added. Again wash with alcohol, allow to dry, dissolve the precipitate in hot water and collect the solution in a weighed glass dish. Evaporate to dryness, dry at 105° and weigh as $K_2P_2Cl_6$.

Convert the weight to K_2SO_4, deduct from the weight of the combined alkali sulphates, to obtain the weight of the sodium sulphate.

Factors:

$K_2P_2Cl_6 \times .1938 = K_2O$; $K_2P_2Cl_6 \times .3584 = K_2SO_4$

$Na_2SO_4 \times .4364 = Na_2O$

The Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials, and Glass Factory Equipment and Operation

Published Monthly

Copyrighted, 1926, by

GLASS INDUSTRY PUBLISHING COMPANY, INC.
50 Church Street, New York

Telephones { Cortlandt 2465 / Cortlandt 5618 — Cable Address, Glasdustry

J. B. KRAK, Technical Editor

Subscription Price.....$2.00 a Year
Single Copy.....20 Cents

THE GLASS INDUSTRY circulates extensively among American and foreign glass manufacturers, their business executives and technical and factory operating staffs.

ADVERTISING RATES SENT ON REQUEST

Vol. 7 JUNE, 1926 No. 6

CONTENTS

	Page
Keeping Records of Gas Producer Operations	129
The Frosting of Glass	131
New Glass Transmits Ultra-Violet Rays	136
The Testing of Milk Bottles	137
The Melting of Yellow Glass	139
The Laboratory	
Valuation of Aluminum-Bearing Materials	140
Editorial:	
Training Employes for Advancement	142
Technical Consultation Service:	
Seedy Glass	143
Sandless Glass	143
Asserts Foreign Plate Glass Hurts Domestic Industry	143
Container Manufacturers Meet in Canada	144
Recent Patents	146
The Glass World and What It Is Doing:	
Ornamental Glass Wanted	149
Lighting Fixture Industry Objects to New Lamp	149
Hocking Glass Interests Enter Monongah Glass	149
Industry Contributing to Scientific Research	149
April Plate Glass Production	149
Trade Activities	150
Industrial Publications	151
Personals	151
Recent Deaths	151
Coming Meetings	151
Inquiries Received	151
What the World Wants	151
Glass Stock Quotations	151
Current Prices of Glass-Making Materials	152
Monthly Summary of United States Foreign Commerce in Glass	152

CLASSIFIED BUYERS' GUIDE, PAGE 22

INDEX TO ADVERTISEMENTS, PAGE 24

Training Employes for Advancement

It is one of the real problems of industry: finding competent men and getting them to do the kind of work for which they are best fitted and in which they can rise. The larger and more complex an organization becomes, the more men of brains are required to manage its numerous details.

This topic was ably discussed at a recent meeting of the American Management Association, held in New York City, by Frank Cushman, chief of the industrial education service of the Federal Board for Vocational Training.

Dealing generally with industry's efforts to equip its employes for advancement, he said in part:

"Despite the theory that most men seek advancement in their work, the proportion who are willing to assume further responsibility is only between 2 and 5 per cent. The remainder are willing to go on with the job on hand as long as a decent wage is available. They will not train themselves to take on new responsibilities. The employer's task is with the first group, men who study on the side or attend night schools or take extension courses. The employer should lay out a sensible program for these men that will teach them the underlying principles of their work and show them meanwhile how this training is leading to definite advantage.

"Foreman can be used as instructors in this group, while keeping the larger group capable of turning out the work at hand and maintaining plant efficiency. Pride in his own work is a requisite. Foremen's conferences are a great aid."

One of the largest concerns in its line has developed a way to help uncover latent and draw worker and employer closer together, by what is termed the "suggestion system." Employees are encouraged to make suggestions, in relation to any phase or detail of the company's business. Cash awards are paid for those that can be applied in proportion to their merits.

Hundreds of suggestions were submitted as a result of this plan. They covered every branch of company activity, the majority being on the subject of prevention of waste, economy in production, improvement of operation, better working conditions and greater safety.

This concern reports an annual saving of not less than $20,000 effected by following up worth-while suggestions, received from its own workers. This includes only such economies as can be determined on a money basis. Awards have been paid also in cases where specific savings could not be figured.

In commenting on the success of this system the company expresses itself as follows:

"Although the suggestion system has been well worth while as an economy and efficiency measure, the company feels that it is even more worth while for the opportunities which it opens to its employes. It encourages them to study the company's business and to be on the alert for better ways of doing things. It gives them a voice in company affairs because it insures careful investigation and consideration of their ideas. It especially gives them a chance to reveal themselves to the management as able to think to some purpose about their work and so draw the attention of the management to their special aptitudes."

Technical Consultation Service

QUESTION 93. SEEDY GLASS. We have been having trouble for some time with seedy glass in our tank. The tank will clear up and then come in patches of seeds. We feel that our batch mixture may be in some way to blame for this condition and wish you would check it up and see if our proportions are right and if any ingredients should be added to correct this condition. Our tank is kept at about 2,500 deg. F.

Our batch is:

Sand	1,000 lbs.
Soda	375 "
Lime	80 "
Antimony	2 "
Arsenic	1 "
Feldspar	5 "
Selenium color	7½ oz.

ANSWER. We have gone carefully over the batch composition given in your letter, and are of the opinion that you are making a glass which is too low in lime. It is very probable that a properly balanced batch will not show as much seed as you are having at the present time.

We would suggest therefore the following batch:

Sand	1,000 lbs.
Soda ash	375 "
Lime	100 "
Arsenic	1 "
Feldspar	5 "
Selenium color	7½ oz.

We do not see any use in adding two pounds of antimony to the batch, and unless you have some particular reason why this addition should be made, we would suggest omitting this material.

It is advisable to make the change to 100 lbs. of lime very gradual, as otherwise you will be bothered with lines and waves in the glass. We would suggest that you add two pounds of lime to the batch each day. In this way you would have the desired batch composition in ten days. This seems a long time, but it is best to make such changes gradually, as a sudden change may ruin a tank of glass.

We have seen batches for pressed ware having as much as 400 pounds of soda ash per 1,000 pounds of sand, and which gave excellent results. We believe that your batch could be higher in soda ash, but it would be advisable to confine yourself to only one change at a time.—J. B. K.

Sandless Glass

Reports which have been in circulation recently to the effect that the laboratory of Cornell University at Ithaca, N. Y., has succeeded in producing glass of high quality without the use of silica sand have been confirmed by Professor L. M. Dennis, head of the department of chemistry, who after years of experimentation is employing germanium oxide as a substitute for sand, producing the glass in substantial quantity.

Whether the new glass has properties that will make it of great value for optical purposes is still undetermined, but the results thus far obtained indicate quite clearly that it has unusual refractive qualities.

Germanium, a rare, costly and mysterious element is extracted from crude zinc oxide. In crystalline form it is a glossy, flaky substance resembling zinc, hard and extremely brittle. It is worth many dollars a gram, and Cornell exhibits the largest mass of the element ever assembled, a round piece, beautifully crystalline, about the size of a silver dollar and weighing 104 grams.

It has been learned that crude zinc oxide can be heated with strong acid under such conditions that a volatile compound of germanium of high purity distills over. This is decomposed by water so as to produce pure germanium oxide, a white powder. Professor Dennis further discovered that ingots of the pure metal could be obtained by causing fusion of the powder under ordinary salt.

Laboratory tests disclosed that a gram of germanium could be extracted from a pound of zinc, and the production has since proceeded on this basis.

Asserts Foreign Plate Glass Hurts Domestic Industry

In the May 15 issue of Dow Service Daily Building Reports, market conditions as affecting the glass business in New York City are discussed by Alan E. Beales as follows:

"Current changes in discounts off window and plate glass price lists to the New York City building construction industry tell a tale of protection that does not protect to at least one American industry.

"An inquiry among New York City jobbers to determine the cause of the continued ragged condition of the glass business during a period in which all other branches of the construction business has enjoyed its share of the national prosperity brought out the unanimous reply that this city and other places along the Atlantic Seaboard are being glutted with glass of foreign manufacture, that American glass manufacturers are being seriously injured by the invasion here of European-made glass and that the heavy inroads of glass made under cheaper conditions across the water has brought the domestic industry to a point where it is unprofitable now even to distribute the American product.

"The whole glass trade is wondering why the United States Tariff Commission, after recent hearings before the Senate Investigating Committee, and after inquiring into the situation concerning the proper protection of the glass industry for three years, should now order another investigation that, based upon the time it took to conduct the last one, will give this industry, which Congress very evidently intended should have adequate protection, no hope of obtaining relief for three, if not five, years.

"More than three years ago, it seems the Tariff Commission ordered an investigation of the plate glass schedule upon the then earnest representations of the leaders of this great American industry, that unless some help was given under the tariff laws, great loss would be sustained, both in money and prestige.

"It took the commission two years and a half to complete its investigation and publish its findings. A public hearing was held late in November, 1925, when it developed that plate glass manufacturers in Europe and England had been shipping into this country during the entire time that the investigation had been proceeding, one-quarter of the competitive glass business of this country. The commission's own reports indicated that the advantage in cost enjoyed by the plate glass manufacturers in Belgium was not nearly measured by the United States manufacturers' cost.

"Notwithstanding all this evidence the Tariff Commission then proceeded to order another investigation which is now in progress. It appears to be beyond the understanding of the American window and plate glass interests why this great American industry should be deprived of protection that it now vitally needs.

"The only actual figures which the Tariff Commission's representatives obtained in Europe, according to the trade, were given by an American manufacturer who owned a plant in Belgium as well as one in the United States, wherein it appeared that the difference between the average cost of making glass in this country and the cost of manufacturing glass in Belgium was enough to pay the American duty and allow a profit of fully five cents a square foot to Belgium-made glass when selling at the American manufacturers' cost, before distribution to jobbers and thence into the American market.

"It is not window and plate glass alone that is suffering today from inadequate tariff protection. The brick industry also feels the encroachment of brick made on the other side of the Atlantic and shipped here to be sold in competition with that of American make.

"The effect of present conditions upon glass prices is best revealed by the current discounts as applied to price lists quoted in today's *Architects' Weekly Building Material Price Supplement*, published by the Dow Service. These discounts on window glass run as high as 89, 88 and 87 per cent off window glass price lists and on plate glass price lists the discounts ruling today, for the most part, are 85 and 87 per cent."

SUBJECT INDEX TO UNITED STATES GOVERNMENT MASTER SPECIFICATIONS—MISCELLANEOUS PUBLICATION No. 73. May 1, 1926. Price 5 cents. An alphabetical list of commodity specifications officially adopted by the Federal Specifications Board including about 600 items. These specifications are in printed or mimeograph form and can be obtained in some cases from the Federal Specifications Board, Bureau of Standards, Washington, D. C., and in other cases must be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Container Manufacturers Meet in Canada

The first meeting of the Glass Container Association ever held in Canada took place at Montreal on May 13, 14 and 15 and proved to be a great success, the attendance, of over one hundred, being reported the largest recorded at any annual meeting of the association. The Canadian members and their friends who acted as hosts to the visitors were very attentive and saw that all of them were well taken care of. A strong feeling of fellowship prevailed and during the occasion many subjects of interest to the members were discussed both informally and at the meetings. Sir Charles Gordon of the Dominion Glass Company, Ltd., headed the committee which had charge of the affair.

On the morning of May 13 the visitors were welcomed by Alderman T. J. Holland, representing the city of Montreal.

President Frank Ferguson at the first of the meetings made an interesting address, bringing out among many interesting points the following:

"Idle plants are expensive, superfluous stocks depreciate, tie up our money and add to the already high cost of doing business. The industry has operated only about 74 per cent of its capacity since September and in March ran only about 68 per cent, but in spite of that we have about nine weeks' stock on hand."

Mr. Ferguson also referred to the proposed plan for conducting an aggressive advertising campaign to increase the consumption of bottles. Nothing definite was done about the matter at this meeting. Discussing the expansion and work of the association, he said that he favored within the association, group formations among manufacturers making similar classes of ware, with the idea that each group would deal with questions affecting manufacturers in that particular line, while the association as a whole deals with matters affecting the whole industry. Numerous other subjects were also covered by the President.

Business affairs of the association were discussed at the annual business meeting on Friday morning. President Frank Ferguson will continue in office another year and the five directors whose terms had expired, were re-elected as follows: James Morrison, G. S. Bacon, R. E. Walker, A. H. Grier and R. T. Cunningham.

The association's Statistical Director, Fred J. Rummel, at the afternoon session, at which J. S. Algeo of the Hazel-Atlas Glass Company presided, presented a report showing that production during the seven months ending March, 1926, had exceeded shipments. In addition to preparing statistics, Mr. Rummel's department is working on the creation of a uniform system of cost accounting. During this session short addresses were given by over a dozen glass members.

R. E. Walker, secretary and treasurer of the association, was unable to attend the meeting but his report was read and approved.

Director John C. Magness of the traffic department presented an interesting report of that department's activities. A report of the membership committee was submitted by J. H. Graham of the J. T. & A. Hamilton Company, Pittsburgh, Pa. Reports were also received on the tariff question, research, and standardization of bottle finishes, caps and closures.

Judge I. G. Jennings, business manager of the association addressed the meeting.

A banquet held on Friday evening was a most enjoyable occasion. Sir Charles Gordon, the president, and A. H. Grier, general manager of the Dominion Glass Company, both addressed the gathering.

Quite a number of the members were accompanied by their wives, daughters or sisters, who were pleasantly entertained by a committee under the leadership of Mrs. I. R. Macdonald.

An interesting incident during the convention was the presentation by James Morrison, representing the executive committee, of a walking stick intended as a token of esteem from the members of the association, to George W. Yost, affectionately called the dean of the bottle trade, formerly president of the Bellaire Bottle Company, for several years president of the National Association of Bottle Manufacturers, and at present an honorary director of the Glass Container Association. Mr. Yost has not been active in business for some years past but that he has been missed is very evident from the good feeling manifested when the presentation was made.

John Rau, vice-president of the Fairmount Glass Works, Indianapolis, Ind., won the golf tournament which was held on Saturday, May 15, and was presented with an umbrella. The tournament comprised eight foursomes, the winner of each foursome being presented with a box of one dozen golf balls.

W. H. Boshart at the Friday meeting delivered an important address, which follows:

Facts Should Govern Our Industry

By W. H. Boshart, President and General Manager, Owens Bottle Co.

As I prepare to put these few thoughts on paper, a picture presents itself of a great industry as it was and as it now is, and of the many changes that have taken place within our memory, in that industry. Also, what should be done for betterment, but which is not being done.

Prior to the advent of the machine in bottle making, the art had progressed very little beyond the practice of the ancients. Bottles, as made in the old days by the hand process, were crude indeed, and very irregular in their various factors—weight, capacity, corkage, etc. Because of labor conditions, the practice of employing many minors, and the weather conditions during the warm months, the producing of bottles was very irregular and very uncertain.

The machine, of which there are various types, has brought about a complete revolution in this great industry. It has brought almost to a state of perfection the bottles now produced, and has also brought about an immense increase in their use, for they can now—because of their uniformity—be machine filled, machine labeled, machine capped and machine packed.

In a very substantial way the machines have kept down the cost of making bottles, and at the same time have improved their quality. The relatively low prices at which bottles can now be obtained have opened up many new avenues for their use and increased their use where formerly employed. If, in connection with the present high costs of materials entering into glass making, we still had to make use of the highly paid hand operators of earlier days, the finished cost of bottles would be such as to make their price so high that they could not be used in many businesses where they are now freely made use of.

While we can take pride in this great development in the art of bottle manufacture, and can view our achievements with pleasure, it has brought us new and pronounced problems. One of these is the pronounced over-capacity for bottle making now in existence.

I think I state the fact conservatively when I say that the industry has plant equipment 30 per cent beyond the normal requirements of the country. In other words, if by any chance all the producing capacity would be in operation at one time, the country could not by any possibility consume more than 70 per cent of the bottles that would be produced. This over-capacity has been brought about in several ways.

Prohibition has had much to do with it, as it removed from our field practically all the bottles formerly used for beverages of alcoholic character.

Futhermore, it should be borne in mind that factories now operate continuously throughout the year, stopping only for necessary repairs, whereas formerly the operating period was for but ten months, July and August being inoperative months.

The over-capacity and over-production has been brought about through the fact that each producing unit now turns out very many more bottles than it formerly did. There has not been in the past ten years any noticeable building of new plants, or additions to old plants, but notwithstanding this the increase in production has continued. Furthermore, there has been in the last several years a further increase in production per machine, as organizations become more efficient and better understand how to operate the machines.

With the advent of the machines into bottle manufacture began an improvement in the character of the organizations engaged in the business. The organizations today, much more so than did those formerly, inquire more carefully into those concrete and abstract problems that have or may have a

bearing upon the business, and especially inquire more carefully into everything that has an effect upon costs.

The executives today who are careless in giving due weight to all trends and movements that may affect consumption, production and costs, will fall far short of measuring up to the present-day requirements.

It is highly important that everyone engaged in bottle manufacture give serious thought to this condition of excess producing capacity. It is quite natural for organizations to feel that inasmuch as they have a certain producing capacity, all of it should be employed and made to work. But any executive who allows that thought to dominate his actions, and who brushes aside the patent fact of over-production, and fails to give to that fact due and proper consideration when outlining his operating plans, will impose upon his own organization a very serious burden, as well as impose a handicap upon the whole industry.

In our business we have not been influenced by anything other than what we conceive to be along the lines of sound business judgment. We might have been able, through greater selling effort, through price concessions and in other ways to go into the market and get increased business, but we realized that to do so would bring about a national disturbance that in the end would be hurtful to ourselves. We feel we should not attempt to do more than we can properly obtain through normal effort.

I find various of the activities of the Glass Container Association to be an indispensable aid. Particularly is this true of the capacity and production reports and other reports coming from the statistical committee.

Manufacturers and others seeking knowledge of the factors responsible for business conditions, are no longer estopped from gathering and exchanging those figures needed to furnish information on production and sales problems.

What the executive needs today, more than all else, is facts, and he wants these as free from guesses as they can be obtained. The production and capacity report enables the active executive to more correctly chart the business of which he is the head. He has before him these reports, presented to him in a way which shows clearly the direction in which the whole industry is moving. He can have before him accurate figures for practically the whole industry, the actual production of the industry, the shipments made, the amount of unfilled business on hand, and the finished stock in manufacturers' warehouses. He can then, knowing his own figures for these various movements, note with an accuracy not in any other way possible, how the movements of his concern compare with the industry as a whole. If the Glass Container Association did no more than place these figures on my desk, I would feel that it probably earned all that it was costing. What we need more than ever before in this industry, are facts: facts presented in such a way that the story they have to tell can be readily understood and applied in our daily business activities. Industry in this country cannot be successful unless it has facts to guide it.

If you will refer back to the various speeches made by Mr. Herbert Hoover, Secretary of Commerce, you will find that he repeatedly emphasized the need for the business men of this country basing the guidance of their respective enterprises on facts and conditions as they exist, not only at present, but as they are going to exist in the future.

We have arrived at the conclusions with respect to overcapacity and over-production very largely through our analysis of these reports and is my hope that they will be continued and that we will all contribute as required, accurate figures for each month of our business. Whatever we may do, or whatever we may not do, will have a very large effect upon all of us, and if we do the right thing, we will be benefited; if we do the wrong thing, we will be hurt, and we can be aided to do the right thing if we have accurate information obtained through these reports, and if the reports are accurate and maintained, all will be benefited.

The results achieved by the traffic department of the association, which I consider highly commendable, have been brought about by the intelligent presentation of facts. It has been necessary to educate the railroads on what the glass container is; that it is very desirable freight; that articles in glass can be handled without danger; that freight rates play a very important part in our business, and they have been shown the competitive features between glass, tin, paper and wood, which has broadened their understanding of the position the glass container occupies in human progress. The item of freight on inbound fuel and raw materials plus the freight or the container from the factory to the customer is larger than any other single item of expense. Keeping our hand on the pulse of the transportation industry so far as it affects us directly or indirectly is of great importance. The day of dealing individually on matters of wide importance is past, and results can only be obtained by having an entire industry speak for itself with facts.

Notwithstanding some rumors and reports that we hear from time to time to the contrary, I am very much inclined to be optimistic in a modest way as to the immediate future of demand for our products. I do not think there has ever been a time when all conditions were more favorable than they are today.

Money is in fair abundance, readily and easily obtainable for legitimate uses. There is not excessive stock in the hands of users. Labor is well employed at wage rates proportionately above anything that has heretofore existed under like business conditions. There is no major labor trouble anywhere and no apparent labor unrest. Farming conditions are very much improved over what they were several years ago and the farmer has more surplus on hand. Railroad earnings exceed any amount that has been in evidence for many years, and there is ample surplus of earnings by the railroads to keep up equipment and developments of their properties. The foreign situation, while still very much disturbed, is much better than it was a year or several years ago, and is directly headed along lines that indicate an early stabilizing of the financial structures of the various European countries. The political situation is more favorable than it has been in the past twenty years. There is no outstanding radical agitation at Washington, and there is a party responsibility that forebodes well for the future. No matter which way you look, no matter which way you turn, there seems to be in sight nothing but favorable omens. I do not believe these necessarily mean that we are in for a period of expansion and a period of extraordinary demand. On the contrary, I am inclined to view these favorable conditions as indicating that we have fairly clear sailing ahead of us, but that we must keep our own house in order and conduct our various businesses in the light of and under the guidance of facts, and we must have the courage to do whatever is necessary to do, in order to give to these facts correct application.

Just a word on what should be done for a betterment but which is not being done. In my opinion, our Glass Container Association is not making any progress to speak of in the work of creating greater use for present glass containers, and developing new uses for same. This was the principal thought we had in mind when the Glass Container Association was formed, and it has been a matter often touched on since, but very little in this direction has been accomplished. National advertising, or some other method of constructive advertising probably is the only way to handle the situation. If such is the case, some constructive movement should be carefully outlined for the endorsement of the membership, and if approved, then the same should receive unanimous, unremitting and enthusiastic support.

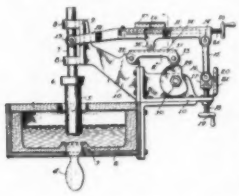
In conclusion, gentlemen, permit me to express the hope that in the deliberation of this meeting of the Glass Container Association, you will find some suggestion, some thought, some inspiration that will touch the most sensitive nerve in your business anatomy—the pocket nerve. After all, money is what we work for—not because it is money, but because money is the measure of success and we want to all feel that we are successful. Let us leave this gathering influenced by what we have heard and the contacts we have had here, determined to make of this glass industry what it is destined to be—one of the greatest industries of our two countries. Let us pay this compliment to our Canadian brothers, who have so splendidly received us, that we found when visiting in their beautiful city of Montreal, inspirations that have enabled us to do in a larger way, all of those things necessary to the development, the enlarging and the perpetuation of this great association.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

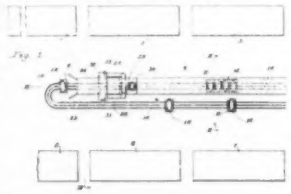
Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

GLASS FEEDER. U. S. 1,582,725. Apr. 27, 1926. Albert R. Bethel and Josiah H. Williams, Los Angeles, Cal. Filed 12/29/24.

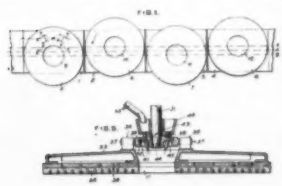


The primary object is to provide a feeder, embodying a reciprocating plunger and means for actuating the same, wherein the operation of the actuating means may be governed or controlled for regulating the feed motion of the plunger for the discharge of charges or gobs varying in size or quantity as may be desired. A further object is to provide a plunger actuating mechanism including a lever for transmitting motion to the plunger and controllable means for varying the working action of the lever from a source of power, whereby the range of working motion of the plunger may be varied. A still further object is to provide means whereby the plunger actuating lever may be adjusted to set the feed plunger at a determined upper limit or starting point, from which its range of downward motion for a feed action may be governed or controlled.

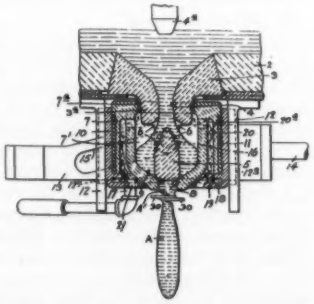
APPARATUS FOR MAKING PLATE GLASS. U. S. 1,583,817. May 11, 1926. William G. Watson, Ford City, Pa., assignor to Pittsburgh Plate Glass Co. Filed 8/18/23. The pots are carried from the pot furnaces to the cars on the track 10, conveyed to the left hand end of the kiln and moved slowly through the kiln until they emerge at the right hand end, rate of movement and temperature being so adjusted that pots emerge from the kiln with glass at a proper temperature for casting.



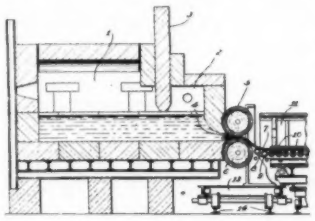
GRINDING MACHINE. U. S. 1,583,807. May 11, 1926. Jacob Soderberg, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 10/11/22. A grinding machine for sheet glass comprising a bed or table mounted for longitudinal movement and carrying the glass sheet to be surfaced, a plurality of horizontal grinding discs, having their centers open, arranged in two sets or series along the table with their axes of rotation off center with respect to the longitudinal center line of the table.



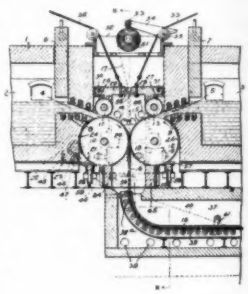
METHOD AND APPARATUS FOR FEEDING MOLTEN GLASS. U. S. 1,583,932. May 11, 1926. John R. Keller, Glenshaw, Pa., assignor to Hartford-Empire Co. Filed 6/26/23. The method of feeding molten glass that comprises establishing a continuous vertical descending stream of molten glass, dividing said stream, receiving the divisions of said stream in a receptacle, periodically accumulating a mass of glass in said receptacle, heating the exterior of said receptacle, periodically reciprocating said receptacle vertically and thereby periodically discharging the accumulated glass through an opening disposed vertically below the said initial continuous stream, and severing mold charges from the glass thus discharged.



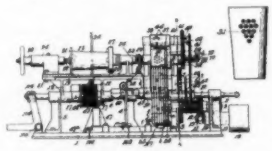
PROCESS AND APPARATUS FOR MAKING SHEET GLASS. U. S. 1,583,779. May 11, 1926. Karl L. W. Core, Ford City, Pa., assignor to Pittsburgh Plate Glass Co. Filed 7/9/25. In many cases, the rolls become wrapped and are bowed away from each other at the center, so that the glass sheet or ribbon produced is substantially thicker at the center than at the edges. The present invention provides a means whereby the variation in the thickness of the sheet is reduced to a minimum. This result is accomplished by providing for the adjustment (circumferentially) of one of the rolls with respect to its driving roll and with respect to the other roll so that the bowed surfaces of the rolls on opposite sides of the pass are brought into substantial parallelism.



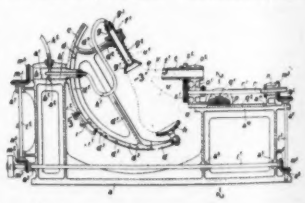
APPARATUS FOR MAKING SHEET GLASS. U. S. 1,583,793. May 11, 1926. William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 9/26/22. An arrangement for continuously forming and welding together two ribbons of glass, such operation giving an opportunity, to feed between the ribbons as they converge, the wire mesh or other reinforcing means which is to be incorporated into the finished sheet. The ribbons are drawn from opposing tank chambers and then turned vertically between a pair of rolls where the two sheets are welded together, the wire mesh being introduced at this point.



MACHINE FOR CUTTING DESIGNS ON GLASSWARE. U. S. 1,583,691. May 4, 1926. Hugh G. Hill, Wheeling, W. Va., assignor one-half to Eliza O. Porter. Filed 3/26/24. An engraving machine in combination with an engraving wheel, a rotary ware support, means for rocking said support toward and away from said wheel for carrying the ware into and out of operative relation to said wheel at predetermined intervals, means holding said support against rotation while it occupies its forwardly rocked position, and means for intermittently advancing said support.

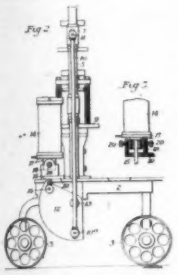


DEVICE FOR FUSING GLASS EXTENSIONS ONTO GLASS VESSELS. U. S. 1,584,661. May 11, 1926. Erich Schott, Arthur Hasenstein, and Karl Ditscher of Jena, Germany, assignors to firm of Jenaer Glaswerk Schott and Gen, of Jena, Germany. Filed 10/22/25. A device for fusing glass extensions onto glass vessels, glass tubes and the like, containing a base plate, a gripping device rotatably supported on this base plate, this gripping device being adapted to receive the vessel to be worked in such a way that its longitudinal axis intersects the axis of rotation of the said gripping device, and a second gripping device supported on the base plate rotatable about the same axis as the first gripping device and adapted to receive the extension to be fused on, at least one of the said two gripping

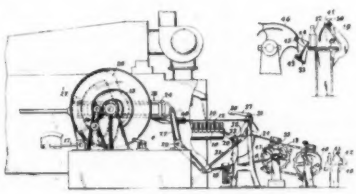


devices being displaceable relatively to the base plate in the direction of the said axis of rotation.

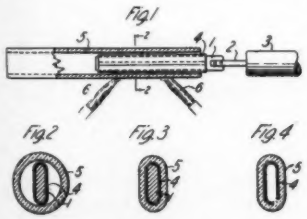
POWER-OPERATED GLASS PRESS. U. S. 1,584,672. May 11, 1926. Edwin E. Slick, Pittsburgh, Pa. Filed 10/13/25. In certain types of glass forming machines, particularly machines having a single mold, it has always been the practice to operate the plunger of the machine by a long handled lever. It is proposed to provide a power actuating means for the plunger which will effectively actuate the plunger and which is so connected with the plunger as to increase the pressure as the plunger reaches the limit of its pressing stroke. It is furthermore proposed to provide a power actuated means which is readily applicable to machines of the type now in wide commercial use without any considerable modification of the construction of the machine.



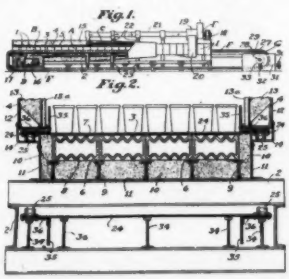
MECHANISM FOR TRANSFERRING WARE FROM LEHRS. U. S. 1,583,428. May 4, 1926. Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co. Filed 12/15/22. The combination of a lehr, conveying mechanism within the lehr, lehr pans mounted thereon and adapted for holding articles in rows extending transversely of the lehr, a conveyor outside of the lehr, and means operable to transfer said articles a row at a time from the lehr to said conveyor while supported in the lehr pans and place them in an upright position on the conveyor in a row extending lengthwise of the conveyor.



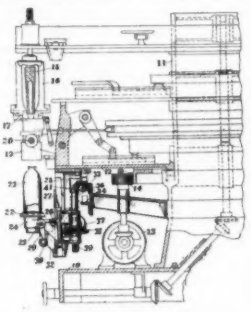
METHOD OF FORMING GLASSWARE. U. S. 1,583,464. May 4, 1926. William G. Houskeeper, South Orange, N. J., assignor to Western Electric Co. Filed 9/13/24. A solid metal form or core having approximately the dimensions of the interior of the passage to be obtained is provided with a closely fitting sheet of thin metal foil. A glass tube or vessel is slid over the core and foil and the glass softened and pressed into contact with the metal foil. The core is withdrawn while the glass is sufficiently viscous to retain its shape leaving the metal foil in contact with the interior surface of the glass. The glass is allowed to cool slowly and when cold the metal foil is dissolved with acid after which the glass vessel is ready for use. Fig. 1 shows method of forming the glass vessel on the metal core.



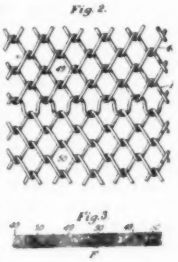
APPARATUS FOR ANNEALING GLASSWARE. U. S. 1,584,241. May 11, 1926. Vergil Mulholland, West Hartford, Conn., assignor to Hartford-Empire Co. Filed 8/27/25. One object is to provide an endless conveyor, the lateral edges of which extend without the heated tunnel and to which the driving chains are secured where they will not be subject to the high temperature of the tunnel and be conveniently accessible for replacement or repair. The inventor's claims include a glass annealing lehr comprising a tunnel having a bottom, a flexible endless conveyor of woven wire fabric having its ware-bearing strand extending through said tunnel and in contact with said bottom, a sprocket chain secured to each edge of said conveyor, and a driving mechanism for said conveyor including sprocket wheels for engagement with said chains.



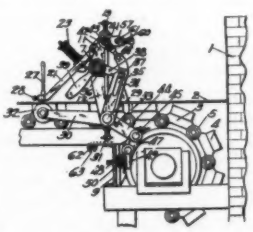
GLASS-FORMING MACHINE. U. S. 1,583,424. May 4, 1926. John F. Rule, Toledo, O., assignor to the Owens Bottle Co. Filed 9/29/22. The combination of a mold carriage, molds thereon, means to rotate the carriage and bring the molds singly and in succession to the same charging position, and means to discharge articles from the molds at a plurality of different positions, said discharging means comprising a plurality of devices each operable to cause the discharge of certain of the articles at a position different from that at which any of the articles under the control of the other discharging means are discharged.



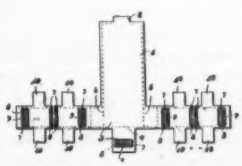
LEHR FOR ANNEALING GLASSWARE. U. S. 1,583,046. May 4, 1926. Henry W. Ingle, Hartford, Conn., assignor to Hartford-Empire Co. Filed 3/31/25. A glass-annealing lehr having an endless belt of reticulated woven wire having the portion thereof that is within tunnel supported entirely by the bottom of said tunnel, and heated by direct contact therewith, for conveying glassware through said tunnel in spaced relation with respect to the bottom portion thereof, to permit of free circulation of convection currents between the bottom of the ware and the bottom of said tunnel. The fabric of the conveyor is preferably constructed of interconnected wires of approximately helical form. The adjacent helixes in such construction form a fabric having a diagonally ribbed surface, which causes a marked tendency for the conveyor to creep laterally through contact between the conveyor and the rollers or other support. This difficulty is avoided by constructing the conveyor of alternate sections 49 and 50 which are respectively woven from right and left hand helixes (Fig. 3).



APPARATUS FOR CUTTING SHEET GLASS. U. S. 1,583,542. May 4, 1926. Enoch T. Ferngren, Toledo, O., assignor to the Libbey-Owens Sheet Glass Co. Filed 3/31/24. In combination with means for feeding a sheet of glass longitudinally, a sheet scoring mechanism comprising a cutter member, a pivotally mounted carrier, a cutter-carrying arm pivoted on the carrier and normally engaging one face of the sheet, a supporting roller pivoted on the carrier and normally engaging the other face of the sheet opposite the cutter, and lever mechanism adapted to either lock the cutter and roller in working engagement with the sheet, or to throw them out of engagement. These mechanisms make continuous score lines adjacent the sheet edges whereby these sheet edges may be broken away.

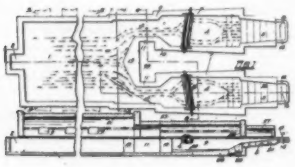


PROCESS OF MANUFACTURING GLASS AND APPARATUS FOR CARRYING ON THIS PROCESS. U. S. 1,582,560. Apr. 27, 1926. Franz Trapschuh, Torrance, Cal. Filed 6/15/25. The process of drawing glass in flat sheets consisting in melting the raw material in a melting tank of practically even width so as to provide a flowing of molten material in an even stream from the charging end to the discharging end in the melting tank, bringing the molten material directly into drawing tanks from the wide discharging end of the melting tank, and drawing glass from the drawing tanks with the first drawing suitably close to the melting



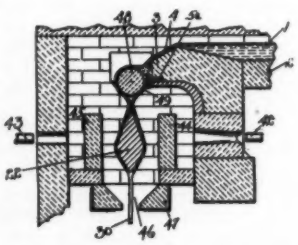
tank so as to eliminate additional heating at points between the melting tank and the first drawing machines in flat sheets, one transversely across the head-end of the melting tank and the other flat sheets parallel to the longitudinal axis and direction of movement of the melting body of glass and with the last drawing close to the outermost edge of the body of molten glass.

CONTINUOUS TANK FURNACE. U. S. 1,581,338. Apr. 20, 1926. Enoch T. Ferngren, Toledo, O., assignor to Libbey-Owens Sheet Glass Co. Filed 10/27/23.



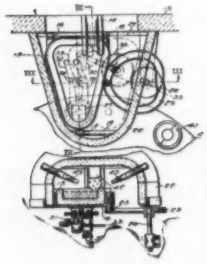
One object is to provide such a design of furnace construction, and such improved heat distribution, that the currents of hotter glass will be equally distributed at both the inner and outer sides of the refining and cooling tanks. The invention comprises a furnace for supplying molten glass to a pair of glass-working machines, comprising a melting tank, a pair of parallel refining tanks, and passages connecting the discharge end of the melting tank with the receiving end of the refining tanks, the center lines of the passages being further apart than the center lines of the refining tanks, and a floater positioned transversely in each refining tank, the floaters being deeper at their center portion than adjacent their ends.

FORMING CONTINUOUS SHEET GLASS. U. S. 1,583,541. May 4, 1926. Enoch T. Herngren, Toledo, O., assignor to the Libbey-Owens Sheet Glass Co. Filed 2/25/24.



In an apparatus for producing sheet glass, a pair of directing members, spaced one above the other, around which molten glass streams successively flow before being drawn from the lower member in united sheet form, the lower member having an upper edge for splitting the molten stream received from the upper member, and a lower edge where the glass streams flowing around the member reunite to form the sheet, the side walls of the lower member, down which the molten glass flows, first diverging outwardly at a relatively small angle from the upper edge, and then converging inwardly at a sharper angle to the lower edge.

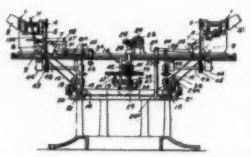
MEANS FOR DELIVERING CHARGES OF MOLTEN GLASS. U. S. 1,581,963. Apr. 20, 1926. Richard La France, Toledo, O., assignor to the Owens Bottle Co. Filed 8/11/20.



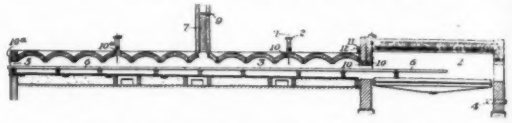
An auxiliary receptacle located outside of the tank into which the glass may flow in a continuous stream. The receptacle is provided with an outlet through which the glass is discharged, and means are provided for controlling the discharge and forming the glass into individual masses or gobs which are dropped into or otherwise transferred to the molds. Mechanism is provided for reciprocating said receptacle in synchronism with the travel of the molds so that said receptacle and gob forming mechanism travel with each mold, permitting the gob to be delivered to the mold, and then return and advance with a succeeding mold.

GLASS SUBSTITUTE. U. S. 1,580,287. Apr. 13, 1926. Jules J. Colle and Archilles Colle, Summit, N. J., assignors to Cello Products, Inc. Filed 3/20/24. An article of manufacture comprising a reticular metallic base covered with a flexible transparent film adapted to wet the strands of said base and follow the expansion and contraction thereof, said film being substantially divided into sections corresponding in number and configuration to the meshes of said base, the shape of each of said sections being substantially that of a divergent lens, whereby a diffusion of the light passing therethrough is effected.

GLASS-CUTTING MACHINE. U. S. 1,582,679. Apr. 27, 1926. James Boyd Greer, Pittsburgh, Pa. Filed 10/22/21. A glass cutting apparatus comprising a base, a table rotatably supported thereby, a plurality of grinding machines mounted on the table each being provided with a chuck for gripping the article to be cut and with a grinding element, means for rotating the table, chucks and grinding elements means associated with each machine for disconnecting its chuck-driving means at a predetermined point in the revolution of the table, for releasing the chuck of each machine at said predetermined point, and for connecting the chuck-driving means of each machine upon the release of the chuck of an adjacent machine.

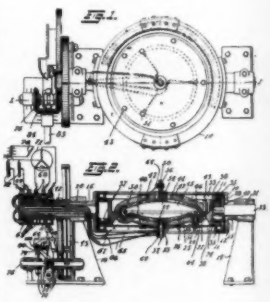


METHOD AND APPARATUS FOR ANNEALING AND COOLING SHEET GLASS. U. S. 1,582,496. April 27, 1926. Otis A. Wells, of Arnold, Pennsylvania, assignor to Window Glass Machine Company. Filed 10/17/24. In the method of annealing and cooling sheet glass, the steps consisting in supplying flat hot glass to a horizontally extending lehr, supporting the glass within the lehr

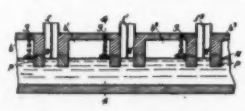


so as to leave a gas space above and below the glass, supplying hot gases to the lehr and permitting the same to pass through the lehr in streams above and below the glass, regulating the cooling effect of one stream relative to the other, confining substantially all of the gases supplied to the lehr within the same until the glass has reached its annealing point, and then withdrawing a substantial portion of the gases, the gases being withdrawn over substantially the entire width of the lehr.

APPARATUS FOR MOLDING AND ANNEALING GLASS. U. S. 1,582,335. Apr. 27, 1926. Walter G. Clark, New York, N. Y. Filed 5/11/20. One object is to provide a mold and furnace combined in a single structure adapted for handling a sufficiently large quantity of glass for casting into a lens for an astronomical telescope or other article and thereafter to hold the glass in the desired form without removal from the furnace until slow cooling has taken place. In this way the formation of objectionable strains in the glass during cooling is avoided. Another object is the provision of means whereby the glass mass may be rotated simultaneously in two places with the application of heat thereto for accomplishing the above object.



METHOD OF CONTROLLING THE TEMPERATURE OF CAST GLASS IN THE MANUFACTURE OF SHEET GLASS BY VERTICAL DRAWING. U. S. 1,582,132. Apr. 27, 1926. Ernest Delacuvellerie, of Dampremy, Belgium, assignor to the Société Anonyme "Brevets Fourcault," of Dampremy, Belgium. Filed 4/16/23.



The method of controlling the temperature of molten glass in the manufacture of sheet glass in glass drawing furnaces consisting in applying heat locally to the portions of the body of molten glass lying contiguous to the walls of the furnace before the glass reaches the drawing chamber of the furnace whereby to maintain the entire mass of molten glass at a uniform temperature during drawing operation.

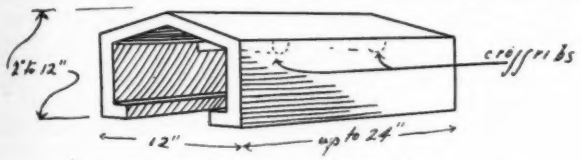
MACHINE FOR CUTTING NON-CIRCULAR GLASSES. U. S. 1,581,883. Apr. 20, 1926. Adolf Steinle, Jena, Germany, assignor to the firm of Carl Zeiss, Jena, Germany. Filed 8/7/23. A machine for cutting non-circular glasses, especially spectacle glasses.

The Glass World and What It Is Doing

News of the Industry

Ornamental Glass Wanted

Architects for the American Permanent Industrial Exposition, who are developing a project at Atlantic City, have in mind in connection with their building program the use of glass to an extent hitherto undreamed of. They believe that unusual effects can be produced by using glass tiles, ornaments and statues liberally in their architectural scheme, the tiles to be used and set in a similar manner to terra cotta tiles. It is thought that the tiles



PROPOSED TYPE OF GLASS TILE

can be cast or blown in molds in sizes up to 2 by 2 feet from ordinary glass and in colors; blue, green and sepia. It is believed that the ordinary imperfections, such as seeds, blisters, etc., would not be detrimental nor would it be necessary to have a perfect match in colors. They believe that it will be practicable to cast or blow ornaments and statues, either whole or in sections, up to 9 feet high. The sketch shows a tentative design for a typical tile. Colonel D. C. Collier, director general of the exposition, is anxious to get in touch with glass manufacturers who might be in a position to co-operate in this matter.

Lighting Fixture Industry Objects to New Lamp

In view of the fact that manufacturers of electric light bulbs are producing and fostering the sale of a new style lamp frosted on the inside and different in shape from the spherical G-18½ and G-25 lamps, the board of directors of the National Council Lighting Fixture Manufacturers on April 21 passed a resolution protesting to the bulb manufacturers that discontinuance of production of the G-18½ and G-25 types would seriously impair the value of many thousands of dollars' worth of special lighting fixture contract work now in the hands of architects, dealers, builders, home owners, churches, banks, etc., which has been designed for the use of these lights and which, with the use of the new type lamps, will be unsightly and unsatisfactory. Another objection of the fixture men to the new lamp, which is frosted on the inside instead of the outside, is that they consider the shiny outside surface "lacks the effect which is essential to good surroundings."

Hocking Glass Interests Enter Monongah Glass

At a meeting of the board of directors of the Monongah Glass Company, Fairmont, W. Va., held on April 28, I. G. Collins, president of the Hocking Glass Company, Lancaster, O., was elected vice-president, taking the place of J. M. Brownfield, who has disposed of his stock and retired from the company. Thomas C. Fulton, secretary and treasurer of the Hocking company was elected a director and secretary and treasurer, succeeding R. T. Cunningham who is reported to have sold his stock also in the expectation of retiring from the business. It was stated that H. L. Heintzelman, will remain president of the Monongah company, while Messrs. Collins and Fulton will take an active part in its management.

The close connection between the two companies is expected to result in substantial benefits to both. The products manufactured by the two companies harmonize quite closely and together constitute an extensive line, the Monongah company adding to the Hocking products pressed and blown tumblers, stemware, decorated glassware, opal ware, etc.

Industry Contributing to Scientific Research

A Washington committee headed by Herbert Hoover, Secretary of Commerce, which has undertaken what it calls "the collection of industry's huge debt to science"—the raising of a fund of huge proportions to be used for research along purely scientific lines—announced on May 13 that contributions amounting to $3,000,000 have already been received. It is proposed that the work shall be directed by the National Academy of Science and the committee plans to establish fellowships for research at various American universities, which would supplement the Carnegie, Rockefeller and other foundations in making opportunities for pure scientific study sufficiently attractive to compete with the high salaries and excellent equipment offered in applied science laboratories of the American industries.

Manchester University Students Visit Glass Works

A group of students from the College of Technology, Manchester University, recently spent an interesting afternoon at the works of Butterworth Bros., Ltd., Manchester, who were founded in 1863. The party, in charge of a lecturer, has for some time past been visiting representative works in different industries. Butterworth Bros., Ltd., is the only firm in England manufacturing fine table and confectioners' glassware in addition to all kinds of glass for mechanical, scientific and industrial purposes.

The making of table glass by hand is an old English craft, and the students showed surprise at the almost uncanny skill of the workers, many of whom have been with the company from boyhood to old age. A contrast was provided later when the modern method of pressing tableware in molds was shown, this being a branch of the industry now making rapid progress.

Pittsburgh Section A. C. S. Visits Plants

On May 21 a party of twenty-six members of the Pittsburgh Section, American Ceramic Society, visited the plants of Laclede Christy Clay Products Company, Rochester, Pa.; H. C. Fry Glass Company, Rochester, Pa., and Beaver Falls Art Tile Company, Beaver Falls, Pa.

The processes of manufacturing glass melting pots, glassware and glazed wall tile proved to be of especial interest to those attending. This trip was taken in place of the regular May meeting.

The annual summer meeting of the entire Society will be held at Philadelphia in June.

Memorial to John A. Voll

A large gathering of national and state labor organizations took part at Zanesville, O., on the last Sunday in May with the Zanesville union in dedicating a memorial to the late John A. Voll. Memorial services were held in Mount Calvary cemetery and a monument honoring the memory of this champion of the cause of the working man was unveiled. In the words of E. R. Madden, however, "the greatest tribute of all is paid him by the employers and employes when they say that 'he was just in the face of everything.'"

Novel Use for Bottles

To test the currents in New York harbor the Board of Estimate and Apportionment of New York City is preparing to set 10,000 bottles adrift there, it was made known at the War Department recently, according to a report in the *New York Times* of May 20.

It is planned to release the sealed bottles from selected points in four lots at biweekly intervals. Each bottle will contain a card asking the finder for certain information to be mailed to the board.

April Plate Glass Production

The production of plate glass in the United States for the month of April, 1926, was 10,725,766 sq. ft., as compiled by P. A. Hughes, secretary of the Plate Glass Manufacturers of America. This is 891,167 sq. ft. less than the April production and 877,446 sq. ft. more than the April, 1925, output.

Plans for the merger of a large number of limestone companies operating in Southern Indiana are being made, with A. E. Dixon of the Consolidated Stone Company proposed as president of the new organization and C. W. Walters of the Indiana Quarries Company as chairman of the executive committee. The Bankers Trust Company of New York heads the syndicate which is handling the matter. A capitalization of $45,000,000 is planned.

The loss of eyes in industrial accidents cost the employers of Pennsylvania more than $800,000 during the past year and more than $8,000,000 since the enactment of the State Workmen's Compensation Law, according to a report made public by the National Committee for the Prevention of Blindness. The compensation paid for loss of eyes amounted to more than for all accidents resulting in loss of legs, arms and hands combined.

The volume of construction contracts awarded in thirty-seven states east of the Rock Mountains in April, according to F. W. Dodge reports, decreased about 5 per cent from the preceding month, but showed a decrease from April of last year of less than one per cent.

The Libbey-Owens Sheet Glass Company on May 17 declared quarterly dividend of 1¾ per cent on outstanding preferred stock of the company and fifty cents per share on the outstanding common stock, payable June 1, 1926, to stockholders of record at 3 p. m. May 22, 1926.

The Austrian and Czechoslovak glass works have formed a cartel which will permit the Austrian works to operate at 50 per cent capacity.

Trade Activities

The Gayner Glass Works, Salem, N. Y., suffered a severe loss of manufactured stock when its warehouse was destroyed by fire on May 8.

D. P. Ogale & Company announce that they recently started a new glass works known as the Nagpur Glass Works, Ltd., at Itwari, Nagpur City, India.

The Interstate Window Glass Company is dismantling its factory at Smithport, Pa., which has been idle for over two years, according to a report from that town.

The Wellman-Seaver-Morgan Company, Cleveland, O., engineers and builders of gas producers for the glass and other industries, have opened an office at 522 Fifth avenue, New York.

The Universal Glass Pressing Machine Company has been incorporated under the laws of Delaware, with a reported capital of $3,000,000 to manufacture machinery for pressing glass.

The New Brunswick Glass Company, Inc., dealers in glass, New Brunswick, N. J., has been incorporated with a capital of $125,000, by William Teitelbaum, W. Goldsburger and B. L. Krieger.

The Graham Glass Company, Evansville, Ind., has about completed construction of a new office building at the corner of Kentucky avenue and Southern railroad, which will house the executive and general offices.

Greiner Glass Manufacturing Company, Inc., manufacturers of opal glassware, formerly located at 1609 Metropolitan avenue, Brooklyn, N. Y., is now located in its new plant at 121 Juniper Valley Road, Maspeth, N. Y.

The People's Glass Company, Elmer, N. J., has been incorporated with a capital of $100,000 to deal in glass and glass products. The incorporators are: William H. Powell, Everett J. Downs, Warren F. Powell and Raymond H. Powell.

The Eden Glass Company, Knox, Pa., which, as mentioned in the May issue, recently began operations, announce through L. D. Richardson, secretary, that they are now operating four hand shops and one automatic machine, giving employment to 110 men and boys.

Application for receivership for the **Citizens Glass Company,** of Barnesville, O., was made in the Common Pleas Court on May 16 by Attorney W. A. Chappelle, representing stockholders. The petition sets forth the liabilities of the company as approximately $50,000, not completely covered by assets.

The North Wheeling Glass Bottle Company's property at Wheeling, W. Va., is to be sold in accordance with an order issued on May 13 by the circuit court of Ohio County, W. Va., with Judge F. W. Nesbitt and K. B. Hall as commissioners in charge of the sale. The plant has not been in operation for the past three years.

Ball Brothers Company, on May 17, began the manufacture of fruit jars, caps, containers, etc., at its Huntington, W. Va., plant, which was formerly owned by the Schram Glass Manufacturing Company. The plant has been equipped with new machinery and it is reported gives employment to approximately 275 men and women.

The Eastern Glass Company, dealers in bottles and jars, of Rochester, N. Y., and New York City, has purchased the plant and office of the Acme Glass Company, Olean, N. Y., manufacturers of bottles of all kinds. The new owners are Samuel Kostin and Samuel Glickstein. The Acme plant will be under the management of W. B. Snell.

The Marienville Glass Company, Kane, Pa., announce that $4,000 par value of first mortgage 7 per cent five-year gold bonds dated November 1, 1922, have been drawn for redemption as of May 1, 1926, at their par value and unpaid interest accrued thereon. Three $1,000 bonds include Nos. 3, 9 and 11, and ten $100 bonds are numbered 46, 48, 52, 53, 58, 59, 69, 70, 73 and 85.

The Chapman-Stein Furnace Company, Mt. Vernon, O., recently announced the closing of a contract with the Akro Agate Company, Clarksburg, W. Va., for a recuperative closed pot furnace. Considerations which led to the selection of this type were temperature control features and guaranteed high fuel economy.

The Standard Plate Glass Company, Pittsburgh, Pa., financial report for the first quarter of this year showed a net profit of $27,601, after deducting depreciation, interest, etc. This is equivalent to $1.42 a share earned on $1,931,700 outstanding 7 per cent, prior preference stock. S. P. Congden and R. B. Tucker were elected directors, succeeding Howard Hansell and Warren Hires Turner.

D. A. Taylor, receiver for the **H. Northwood Company,** Wheeling, W. Va., has obtained an order from the United States District Court in Wheeling, calling for payment to creditors of 10 per cent of their claims. The receiver, with the approval of the creditors and stockholders, has made an arrangement with the Gerth's Realty Experts, 505 Fifth avenue, New York, to sell the plant, equipment and stock on hand.

The Hazel-Atlas Glass Company announced on May 3 that it will call in an outstanding bond issue falling due in 1936, the unpaid portion of which amounts to about $500,000. The issue was of a first mortgage type and bears interest at 6 per cent. A substantial saving in interest will result to the company through its action in retiring the bonds, which action has been made possible by its excellent financial condition.

The Lamb Glass Company, Mt. Vernon, O., is reported to have had a suit filed against it in the Federal Court at Columbus, O., by the Hartford-Empire Company, Hartford, Conn., for alleged infringement of feeder patents. It is also reported that the Hartford-Empire Company has begun similar proceedings against the **Nivison-Weiskopf Company,** Reading, O., and the **Obear-Nester Glass Company,** East St. Louis, Ill.

The Window Glass Machine Company, Pittsburgh, Pa., recently obtained an order from the United States District Court permitting it to file an appeal in the Circuit Court of Appeals from the decree handed down January 25 in the infringement suit the Glass Machine Company brought some time ago against the **Pittsburgh Sheet Glass Company.** The District Court held that there had been no infringement of patents by the defendant concern.

The Tygart Glass Company, whose plant at Grafton, W. Va., was destroyed by fire on April 25 with a very heavy loss, announced soon after that temporary arrangements had been made to supply their trade and take care of their contracts through other sources of supply until their plans are more fully developed in regard to future operations.

Industrial Publications

Steam Economy—Catalogue No. S-33 issued by the Republic Flow Meters Company, Chicago, Ill., is described as being more than a catalog because it comprises a compilation of the experience of the company's entire engineering force for a period of several years on the subject of methods for reducing steam costs. Copies may be obtained on application.

Brown Pyrometers—Catalog 15 issued by the Brown Instrument Company, Philadelphia, Pa. A well printed and bound catalog containing 80 pages and cover, with 120 illustrations, many of them in colors. Some of the features covered are: Brown new design recorders, new moisture-proof rotary switches, Champion sillimanite thermocouple protecting tubes, etc. Copies of the catalog will be furnished to interested readers on request.

Personals

Francis A. Emmons, for the past two years advertising manager of Foote Bros. Gear & Machine Company, of Chicago, was recently appointed sales manager.

Edward Bausch has been elected president of the Bausch & Lomb Optical Company, Rochester, N. Y., taking the place of his father, the late John J. Bausch, founder of the business.

F. A. Jones, manager of the properties of the Pittsburgh Plate Glass Company, at White Cottage, near Zanesville, O., has tendered his resignation to that company to take effect June 1. Mr. Jones will devote his entire time to the management of the F. A. Jones Stone and Lime Company, Martinsburg, W. Va., which he acquired several years ago.

Recent Deaths

D. B. Taylor, treasurer and director of the Diamond Glassware Company, Indiana, Pa., died of pneumonia at his home in that city on May 4.

Thomas Jacka, one of the best known glass distributors in the country, died at his home in New York on April 28, at the age of 83. Mr. Jacka was born in England and came to the United States in 1867. In the following year he joined E. F. Holbrook in the glass jobbing business. Later, the partnership developed into the present well known firm of Holbrook Brothers, New York, of which Mr. Jacka was president and treasurer at the time of his death.

Coming Meetings

AMERICAN CERAMIC SOCIETY summer meeting will be held at Philadelphia, Pa., during June. The annual meeting is to be held at Detroit, Mich., February 14 to 19, 1927.

THE SOCIETY OF INDUSTRIAL ENGINEERS will hold its thirteenth national convention at the Bellevue-Stratford Hotel, Philadelphia, Pa., June 16 to 18 inclusive. Papers and discussions will deal with practical methods of eliminating waste.

THE NATIONAL LIME ASSOCIATION will hold its eighth annual convention at French Lick Springs, Ind., on June 8 to 11.

THE AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-ninth annual meeting at Chalfonte-Haddon Hall Hotels, Atlantic City, N. J., June 21 to 25.

THE NATIONAL INDUSTRIAL ADVERTISERS' ASSOCIATION will hold its annual convention at the Hotel Sylvania, Philadelphia, June 22 and 23. It is expected that it will be the greatest gathering of industrial advertisers ever held.

THE SIXTH CONGRESS OF INDUSTRIAL CHEMISTRY will be held in Brussels, Belgium, from September 26 to October 3, 1926.

THE AMERICAN ASSOCIATION OF FLINT AND LIME GLASS MANUFACTURERS will hold its annual meeting at Atlantic City on July 19.

The annual meeting of the AMERICAN FLINT GLASS WORKERS' UNION will be held at Philadelphia, Pa., beginning July 6 after which the annual wage conference between the union and the NATIONAL ASSOCIATION OF PRESSED AND BLOWN GLASSWARE will be held at Atlantic City, beginning July 21.

Inquiries Received

For Further Information Address GLASS INDUSTRY

332. We are interested in having made a number of glass models of our concrete mixing drum. We have two types of drums and we would require not over 150 of each. Can you give us the names of concerns that could do this work for us? (May 1.)

333. (From Russia) I am a specialist in glass manufacturing and am interested in the latest types of machinery, molds, presses, etc., and their operation, as well as in pantographs and machines for preliminary work of glass models. (May 6.)

334. In the construction of a permanent exposition at Atlantic City in order to obtain the proper architectural and artistic effects we contemplate the use of a large amount of cast glass in various forms, and desire to get in touch with manufacturers. (May 19.)

What the World Wants

Specific Inquiries for American Goods Received in the Department of Commerce

India: 20,356, lamp globes and shades.
South Africa: 20,407, glassware and imitation cut glass.
Netherlands: 20,388, small round mirrors in 2 sizes.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, MAY 22, 1926.

Reported by Moore, Leonard & Lynch, Union Trust Building, Pittsburgh, Pa.

	Bid	Ask	Last
American Window Glass Machine, com.	..	..	68
American Window Glass Machine, pfd.	..	..	87½
American Window Glass, pfd	..	..	109
United States Glass	16¾	17	16½
Pittsburgh Plate Glass, com	275	280	280
Standard Plate Glass, com	..	..	5¼
Standard Plate Glass:			
Preferred cumulative	..	..	25⅛
Prior pfd	..	78	78

WHEELING STOCK EXCHANGE, MAY 22, 1926.

	Bid	Ask	Last
Hazel-Atlas	..	..	41½
Imperial	..	..	72
Fostoria	..	..	150
Central	..	..	75

TOLEDO STOCK EXCHANGE, MAY 22, 1926.

	Bid	Ask	Last
Owens Bottle Machine, com	..	..	57⅞
Libbey-Owens Sheet Glass, com	..	..	140½
Libbey-Owens Sheet Glass, pfd	..	..	115¼

READERS WANTS AND OFFERS

Superintendent or Manager

WANTED: Position as superintendent or manager. Married man under forty. Fifteen years as executive in automatic bottle factories. Experience covers wide range of machines and feeders. Address, Superintendent, care GLASS INDUSTRY, 50 Church street, New York.

Lynch Bottle Machines

FOR SALE: Two Model L. A. Lynch Bottle Machines, in first-class condition, operated but one season. Attractive price. Address: Box L. A., care GLASS INDUSTRY, 50 Church street, New York.

Capital Wanted

GLASS MANUFACTURER, having an established business in Bohemia and Germany, producing glass bars, tubing and rods in all colors and of the highest quality desires connection with capitalist or banking house, for the purpose of starting a glass factory in the United States, in order to produce glassware of all kinds, near the point of their consumption. Please send answers under "Colored Glass" to GLASS INDUSTRY, 50 Church street, New York.

Current Prices of Glass-Making Materials

May 21, 1926

Quotations furnished by various producers, manufacturers and dealers

		Carlots	Less Carlots
Acid:			
Citric	lb.	.44½-.45	.44½-.46
Hydrochloric (HCl) 20° tanks, per 100 lb.		.90-1.00	..
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	..	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.00-16.00	..
Tartaric	lb.	..	.29½
Alcohol, denatured	gal.	..	.40
Aluminum hydrate ($Al(OH)_3$)	lb.	.05	.05½
Aluminum oxide (Al_2O_3)	lb.	..	.05
Ammonium bifluoride (NH_4FHF)	lb.	..	.23-.23¾
Ammonia water (NH_4OH) 26° drums	lb.	..	.04
Antimony, metallic (Sb)	lb.	..	.11
Antimony oxide (Sb_2O_3)	lb.	..	.16-.17¾
Antimony sulphide (Sb_2S_3)	lb.	..	.17
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.03½	.04
Barium carbonate ($BaCO_3$)			
Precipitated	ton	47.00-51.00	51.00-54.00
Natural powdered	ton	42.00-44.00	45.00-46.00
Natural, powdered, imported	ton	..	..
Barium hydrate ($Ba(OH)_2$)	lb.	..	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.07¼	.08
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05½	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.04¾	.05-.05½
Boric acid (H_3BO_3)	lb.	.09	.09¾
Refined	lb.	.08½-.09	.09-.09½
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.05-1.25
Yellow	lb.	..	1.40
Chromium oxide (Cr_2O_3)	lb.	.29	.30-.32
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25
Black prepared	lb.	..	.30
Cryolite (Na_3AlF_6) Natural Greenland Kryolith)	lb.	..	.09¼-.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.35
Feldspar—			
100 mesh	ton	12.50-20.00	16.00-22.00
80 mesh	ton	..	..
40 mesh	ton	..	..
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	..
" " 90%	ton	38.00	..
Formaldehyde	lb.	.09	.09½
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.02-.02¾
Black (FeO)	lb.	..	..
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.11	.11¼
Litharge (PbO)	lb.	.10½	.10¾
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)	lb.	..	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.04	.04½
light (in bbls.)	lb.	.22	.24-.25
extra light (in bbls.)	lb.	..	.32-.37
Magnesium carbonate ($MgCO_3$)	lb.	.06¼	.06¾
Manganese 85% (MnO_2)	lb.	.05	.05½
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	19.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08¼	.08½
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.06¾
Hydrated 80-85%	lb.	.05¾	.06
Potassium chromate (K_2CrO_4)	lb.	..	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.07⅞
Potassium nitrate (KNO_3) (gran.)	lb.	.06⅛	.06⅝
Potassium permanganate ($KMnO_4$)	lb.	.14½	.15½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.20
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.20	.25
Salt cake, glassmakers (Na_2SO_4)	ton	20.00-22.00	23.00-30.00
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.46¼
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat per 100 lb.	1.35-1.40	..
Bulk, on contract	Flat per 100 lb.	1.35	..
In barrels	Per 100 lb.	1.69	2.40
In bags	Per 100 lb.	1.45	..
Spot orders	.05 per 100 lbs higher		
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06⅜	.06⅝
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	3.60	4.16
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04⅛
95 per cent	Per 100 lb.	2.63	2.80
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.04¼	.05
Sodium uranate (Na_2UO_4)	lb.	..	1.15
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.35	3.65-3.90
Flowers, in bags	Per 100 lb.	3.00	3.30-3.55
Flour, heavy, in bbls.	Per 100 lb.	2.65	2.95-3.20
Tin chloride ($SnCl_2$)) (crystals)	lb.	..	.43
Tin oxide (SnO_2) in bbls.	lb.	..	.68
Uranium oxide	lb.		
Yellow (UO_3) 100 lb. lots	lb.	..	1.20-1.25
Black (96% U_3O_4) 100 lb. lots	lb.	..	1.90
Zinc oxide (ZnO)	lb.	.07¼	.07¾

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to April 23, 1926

	March 1925 Quantity	March 1925 Value	March 1926 Quantity	March 1926 Value	Nine Months Ending March 1925 Quantity	Nine Months Ending March 1925 Value	Nine Months Ending March 1926 Quantity	Nine Months Ending March 1926 Value
Glass and glass products (total)	.....	$731,196	.....	$756,567	.....	$6,014,822	.....	$6,420,506
Plate and window glass—								
Window glass, common, box 50 sq. ft.	1,630	9,469	2,459	13,903	26,875	133 600	24,115	114,732
Plate glass, unsilvered, sq. ft.	130,028	26,718	128,767	32,892	1,155,098	300.577	1,279,887	293,663
Other window and plate glass lbs.	211,084	25,324	177,214	14,391	1,474,890	155,800	1,860,002	201,296
Glass containers (bottles, vials and jars)	.....	266,113	.....	244,581	.....	2,101,848	.....	2,030,927
Table glassware, plain	.....	147,011	.....	137,859	.....	1,280,187	.....	1,274,049
Table and other glassware, cut or engraved	.....	15,624	.....	11,444	.....	128,334	.....	124,061
Lamp chimneys and lantern globes lbs.	172,301	27,970	168,650	32,087	1,454,964	246,946	1,456,426	292,528
Globes and shades for lighting fixtures lbs.	176,042	44,355	146,060	46,430	1,123,863	314,654	1,324,034	399,064
Chemical glassware lbs.	19,338	16.229	19,962	21,869	196,428	153,138	175,768	166.354
Electrical glassware, except for lighting lbs.	310,779	20,627	290,741	38,115	1,449,641	159,105	2,333,677	250,292
Other glassware	.....	131,756	.....	162,995	.....	1,040,633	.....	1,273,540

IMPORTS

Corrected to April 23, 1926

Glass and glass products (total)	.....	1,406,196	.....	1,789,666	.....	12,810,831	.....	13,345,235
Cylinder, crown and sheet—								
Unpolished dut. lbs.	6,156,015	331,591	5,699,013	303,729	30,197,174	1,623,699	34,922,307	1,714,781
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	37,870	.....	40,620	.....	360,879	.....	368,640
Plate glass dut. sq. ft.	1,281,435	605,645	2,376,239	773,509	11,777,116	5,551.558	14,403,003	5,155.115
Containers—bottles, vials, etc. dut.	.....	25,377	.....	28.670	.....	135,684	.....	172,969
Table and kitchen utensils dut.	.....	3,922	.....	6,967	.....	114,417	.....	113,882
Glassware, cut or decorated dut.	.....	137,561	.....	225,241	.....	1,634,204	.....	2,000.544
Blown glassware, n.e.s.—								
Bottles, ornaments, etc. dut.	.....	45,409	.....	91,075	.....	1,404,409	.....	1,472,131
Bulbs for electric lamps dut. No.	480,268	4,582	1,505,527	24,041	12,129,861	140.467	11,104,692	127,808
Chimneys, globes, shades, etc. dut.	.....	95,203	.....	94,463	.....	854,020	.....	765,723
Articles and utensils for chemical, scientific and experimental purposes dut.	.....	26,888	.....	55,847	.....	244,090	.....	378,220
Other glassware dut.	.....	92,148	.....	145,504	.....	747,304	.....	1,075.422